

**The laboratory, or, School of arts : in which are faithfully exhibited,
and fully explained, I. a variety of curious and valuable experiments
... compiled from German and other foreign authors : illustrated
with copper-plates / by G. Smith.**

Smith, Godfrey, 18th cent.

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*No vulgar Eye enjoys a fond Delight
In Nature's Beauty and Productions bright;
This nursing Mother, is y^e Second Cause
Of Plenty, Life, and uncontrolling Laws;
When Art doth Court her, She unveils her Face,
And shews her Charms to her adopted Race.*

Hulett Sculp

THE
LABORATORY:
Potter O R, *1786.*
SCHOOL of ARTS.

IN WHICH ARE

Faithfully EXHIBITED, and fully EXPLAINED,

- | | |
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| <p>I. A Variety of curious and valuable Experiments in Refining, Calcining, Melting, Assaying, Casting, Allaying, and Toughening of <i>Gold</i>; with several other Curiosities relating to <i>Gold</i> and <i>Silver</i>.</p> <p>II. Choice Secrets for <i>Jewellers</i> in the Management of <i>Gold</i>; in <i>Enamelling</i>, and the Preparation of <i>Enamel</i> Colours, with the Art of Copying Precious Stones; of preparing Colours for <i>Doublets</i>; of Colouring <i>Foyles</i> for <i>Jewels</i>, together with other rare Secrets.</p> <p>III. Several uncommon Experiments for Casting in <i>Silver</i>, <i>Copper</i>, <i>Brass</i>, <i>Tin</i>, <i>Steel</i>, and other Metals; Likewise in <i>Wax</i>, <i>Plaster of Paris</i>, <i>Wood</i>, <i>Horn</i>, &c. With the Management of the respective Moulds.</p> <p>IV. The Art of making <i>Glass</i>; Exhibiting withal the Art of</p> | <p>Painting and making Impressions upon <i>Glass</i>, and of laying thereon <i>Gold</i> or <i>Silver</i>; together with the Method of preparing the Colours for <i>Potters</i> Work, or <i>Delft Ware</i>.</p> <p>V. A Collection of very valuable Secrets, for the Use of <i>Cutlers</i>, <i>Pewterers</i>, <i>Brasiers</i>, <i>Joiners</i>, <i>Turners</i>, <i>Japanners</i>, <i>Bookbinders</i>, <i>Distillers</i>, <i>Lapidaries</i>, <i>Limners</i>, &c. together with the Art of Marbling <i>Books</i> or <i>Paper</i>.</p> <p>VI. A Dissertation on the Nature and Growth of <i>Saltpetre</i>: Also, several other choice and uncommon <i>Chymical Experiments</i>.</p> <p>VII. The Art of preparing <i>Rockets</i>, <i>Crackers</i>, <i>Fire-Globes</i>, <i>Stars</i>, <i>Sparks</i>, &c. for Recreative <i>Fire-Works</i>.</p> <p>VIII. The Art and Management of Dying <i>Silks</i>, <i>Worsted</i>s, <i>Cotton</i>, &c. in various Colours.</p> |
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Compiled from GERMAN, and other foreign AUTHORS.

Illustrated with COPPER-PLATES.

By G. S M I T H.

The FIFTH EDITION,

With Additions of a great Number of valuable Receipts; particularly, A short, plain, and easy Introduction to the Art of drawing in PERSPECTIVE.

L O N D O N :

Printed for STANLEY CROWDER, No. 12, in Paternoster-Row, and
B. COLLINS, in Salisbury. MDCCLXXXVI.

T O

MARTIN FOLKES, Esq;

S I R,

THE honour I presume to do myself in presenting you with a new edition of the LABORATORY, or, SCHOOL of ARTS, will not, I flatter myself, occasion your displeasure, but meet with a favourable acceptance: the reception this book has met with from the public has engaged me to augment this fifth impression with a considerable number of scarce and valuable Receipts and Instructions for the benefit of such as delight in acquiring useful knowledge, and whose endeavours aim at the improvement of their faculties, by trying experiments which have a tendency to their own and the public advantage.

I cannot, without some concern, reflect on the great disappointment I meet with in the publication of a work of far greater consequence*, which Sir, had the sanction and approbation, not only of

* 'The *Acta Germanica*, or Literary Memoirs of Germany, &c.

D E D I C A T I O N.

you, but likewise of a considerable number of other gentlemen of learning and judgment, who deem'd it *a work, which would be both agreeable and serviceable to the public*: but, for want of sufficient encouragement, I have been under a necessity to suspend the farther continuation thereof: however, I still flatter myself, that by your patronage, and the recommendation of those other gentlemen, who are well-wishers, and have already been promoters of it, a subscription will be set on foot, which may enable me to go on with chearfulness, not only to finish the second volume, but likewise to compleat my design.

Be pleased, Sir, to pardon this digression, as foreign to the purpose of a Dedication, and accept of the present performance, in token of acknowledgement for your kind offices in promoting the above undertaking, while craving the farther continuation of your favour and interest, I do myself the honour to subscribe myself,

S I R,

Your most obliged and

most obedient humble servant,

GODFREY SMITH.

The P R E F A C E.

NATURE, the mother of all visible beings; or to speak more Christian-like, the wisdom and power of God, have discovered themselves throughout the universe, in the most admirable and surprizing productions. The wonders and innumerable curiosities of our particular system, ravish the eyes of every beholder, who is thereby incited to acknowledge and adore the Supreme Being, and first intelligent cause of so glorious a frame.

But the manifestation of God's perfections was not the only design of such a profusion and variety of wonders; it was also designed for the present use and benefit of mankind, which is also, properly speaking, a display of the divine goodness. In them we find a plenty of every thing to supply our wants, and all manner of helps to bring to perfection the most useful arts. For though nature has hid the best, and even the richest part of her productions, either in the deep, or in the bowels of the earth, yet is she willing and ready to lay her treasures open to our diligent enquiries, to our contemplation and use. The more a man applies himself to such researches, the better he answers the end of his creation: but the less he is endued with that spirit of enquiry, the nearer he resembles the brutes, who enjoy the present objects, without reflecting on their beauty, variety and usefulness; without attending to any thing else but what makes an actual impression upon their senses. Such are the people who trample on arts and sciences, and despise

The P R E F A C E.

despise those who apply themselves to mechanic arts, as well as such who endeavour to be useful in that respect to their fellow-creatures.

I don't doubt but there will be many of that kind (for with such the world abounds) who will set their wits at work to find fault with this performance, either as to the intrinsic merit of it, the truth of some experiments, or the translator's stile. But to be beforehand with those gentlemen, and to save them some trouble, I freely own myself to be a foreigner, who have had no great share of school, much less of University learning. Nevertheless, I can say without vanity, that I am not destitute of common sense and some share of reading.

I have endeavoured to translate and compile this work in a plain, easy, and intelligible manner; and if there is any fault, in point of grammar, or orthography, gentlemen of good sense and good nature will easily excuse trifles, in consideration of the usefulness of the work itself.

However, we may venture to say, that although it was design'd chiefly for the ingenious lovers of arts, unskilled in languages, with whom most countries abound, yet the learned themselves may find therein variety of matter, not unworthy their notice.

As to the truth of the experiments, I must own, that had my fortune answered my inclination, I would have carefully examined most of them beforehand: but as that was not the case, I shall leave it to those gentlemen whose purses may be equal to the task, to satisfy their curiosity. I have, however, tried some of them, and they have answered my expectation, which

The P R E F A C E.

which gives me room to believe that the rest are as true. Besides, I have consulted people whose province it was to be better acquainted with those particulars: or, when I could not have such an opportunity, I have weighed them the best I could, and duly examined their probability and the credit of the authors; so that I dare say, most, if not all, of those experiments will stand the test.

I know, objections have been raised against a few articles here and there, particularly that concerning *the generation of Silk-Worms out of Veal*; but presume that experiments made to prove the truth of this fact, which we have inserted in this impression, will induce gentlemen not too hastily to form a judgment on the supposed improbability of the thing, but to wait till trials performed by themselves or others shall determine whether such facts really be as they are represented or not.

When first this book was put to press, I had some hints given me, that the publication thereof would give offence to tradesmen or artificers, whose mysteries in their respective professions would be, by that means, laid open to every body. But as this argument seemed to me to be of little weight, I did not think proper to desist from this undertaking: They who are in a good way of business, will hardly neglect it or leave it off, in hopes of making a better fortune by trying of projects. And supposing some ingenious persons should, by their industry, in trying and putting any of the experiments in execution, better their fortune, or get an honest livelihood, where would be the harm? Must a man, for fear of dis-
pleasing

The P R E F A C E.

pleasing a few private persons, be debarred from the knowledge of things, which may be advantageous both to himself and his country, and be denied the satisfaction in curious inquiries? My aim in the publication of this work is to hurt no body, but to oblige the curious and lovers of art and ingenuity, who take pleasure in trying experiments of one sort or other: amusements much more delightful and satisfactory, to some gentlemen, than gaming, hunting, reading of novels, and the like. Artificers and handycraftsmen will find it a very useful performance. They will, perhaps, make some new and advantageous discoveries relating to their trade, which before they were ignorant of. The selfishness and ill-nature of some masters is such, that they will keep their apprentices, during seven years, on particular servile branches, and conceal from them the most essential part of their business, by doing things in private. It concerns those who have laboured, or do labour, under such an unjust or ungenerous proceeding, to strive to be better informed. And to many of such this book will not be a useless purchase, if they peruse with attention, and try the experiments, as far as lies in their power.

As four impressions of these my endeavours have met with a favourable reception from the public, I hope they will, in this fifth edition, share the same fate; the more as the additional number of very valuable receipts and instructions is considerable; they are the fruits of a good intention, and presented to the curious with sincerity.

T H E

T H E
L A B O R A T O R Y;
O R,
S C H O O L of A R T S, &c.

P A R T I.

A variety of curious and valuable experiments in refining, calcining, melting, assaying, casting, allaying, and toughening of GOLD; with several curiosities relating to gold and silver.

✱ ✱ ✱ ✱ ✱ S gold of all other metals is the most noble and most
✱ ✱ ✱ ✱ ✱ valuable, it is justly distinguished from all the rest
A ✱ ✱ ✱ ✱ ✱ by the name of the king of metals. *Europe* as
✱ ✱ ✱ ✱ ✱ well as the other parts of the world, affords se-
✱ ✱ ✱ ✱ ✱ veral gold mines; but *Peru*, in the *Spanish West*
Indies, particularly abounds in them; from whence almost e-
very nation is supplied with it.

Of all metals, gold is the most solid: it consists of particles so fine and closely connected, that it is a difficult matter to separate it: It will resist the fire, and not suffer any diminution by the heat thereof, though never so fierce and violent. It is not subject to rust, but retains its natural colour. Its weight is ten times heavier than earth, and a piece of gold contains seven times the matter that a piece of glass doth of the same magnitude. It is of a malleable temper, and spreads under a hammer more than any other metal, and by the hand of a skilful artist, may be wrought into any form or shape. There is no solid body that can be extended so much as gold; one ounce beaten into leaves, would cover ten acres of ground.

B

Wire-

Wiredrawers extend out of an ounce of gold a thread of 230800 feet long.

Gold being then of a pure and solid substance, its intrinsic value cannot be diminish'd by the most violent fire, nor any other means, but only by the mixing and incorporating it with other metals, and when this is done, its purity or value is distinguished by the number of carats. The finest gold, which is free from any allay, is commonly called gold of 24 carats, and as many carats there be below that number, so much is the gold lessened from its original value, according to the proportion of the allay of silver and copper; so that $\frac{1}{4}$ of silver and $\frac{1}{4}$ of copper to $\frac{1}{2}$ of gold, being incorporated together, makes a gold of 12 carats, and so on.

To separate the gold from the ore.

AT the gold mines in the kingdom of *Hungary* they have several ways of separating it; as burning, melting, and adding silver ore and other minerals, sand and lead, according as the ore is fluid or fixed: for the generality they proceed thus; they break and pound the ore very fine in water; they wash it often, and lay it in powder upon cloths, and by a gentle oblique descent of the water over it, and their continual stirring it, the earthy, clayey and lighter parts are washed away, while the heavier and metallic remain in the cloth: these cloths are afterwards washed clean, in several tubs, and the water, after settling a little, is poured off from its sediment; which sediment is again washed, and stirred up in several vessels and troughs, 'till at length they sprinkle quicksilver upon it, and knead it well together for an hour, and then they wash it again in a wooden vessel; striking the vessel against their leg, they bring the gold and quicksilver together into an amalgama: from this amalgama they strain as much of the quicksilver as they can, first thro' coarse, and then thro' fine cloths; the remaining mass is put upon a perforated plate, which is set over a deep pan placed in the earth, in the bottom of which pan they also put quicksilver; and this pan is covered, and well luted; then they make a charcoal fire upon it, and by that means drive down the quicksilver which might still remain in the gold, to the rest in the bottom of the pan; then taking out the gold, they give it a smart fire, that it may still become purer.

Of

Of SILVER.

THE finest metal next to gold is silver, which is of a more smooth and polished nature than gold; it is malleable, but will not so easily yield or extend under the hammer, neither is it so weighty as gold.

Silver is seldom found in mines by itself, but commonly accompanied or mixed with copper, lead, or gold. That mixed among lead lies in a kind of black ore; but what is found in copper, is for the generality in a hard white ore; resembling crystal. Sometimes pieces of pure silver are found in mines so hard, that it cannot be melted without the addition of a quantity of other silver. There being a great variety of silver ore, both to its mixtures, so likewise to its richness; some containing a great proportion of silver to what others do; 100lb. weight of ore sometimes yields but $\frac{1}{2}$ ounce or an ounce of silver; sometimes 2, 3, 4, 5 to 20 ounces: richer ore is very rare; yet, there has been such as contained half silver, and some so rich, as to be worked into silver utensils without refining it.

A specimen of each sort of ore is carried to an office, called the Test, where its richness is examined into by the following method: they take the same quantity of the different ores, after first drying, burning, and grinding them, and give to each an equal proportion of lead, then melt and purify them, and by exact scales observe the proportion between the ore and its contained metal, and make a report thereof to those employed in the large melting furnaces: If the ore is found to contain $2\frac{1}{2}$ ounces or more to 100lb. weight, they melt it by the help of iron-stone, called *Kys*, and slacken, a scum or cake taken off from the top of the pan, into which the melted mineral runs. If the ore be poorer, and contains only two ounces or less to 100lb. weight, it is first pounded, and then much of the earthy parts are washed away, 'till it becomes richer, after which it is thrown into a furnace with the former materials, where it melts, and runs thro' a hole at the bottom into a pan, placed in the earth before it, and thus exposed it immediately acquires a hard scum, dross or cake, which being often taken off, the remaining metal becomes purer; to which lead is added, and after some time the melted metal is taken out, then being again melted in the driving

furnace, the lead and what else is mixed with the silver is driven off by the blowing of two large bellows, and runs over in the form of litharge; that, which first comes is the white, and that which comes last is the red litharge.

Of REFINING.

REFINING or purifying of gold or silver, is an art by which the impurities that are mixed with these metals are separated, and this is done four ways, *viz.* by parting, the *test**, cementation, and by mercury.

Parting is done with *aqua fortis*; which the refiners make thus: they take of saltpetre 3lb. Dantzick vitriol 2lb. and mix them in a mortar, and put the powder into a long-neck, or earthen vessel, so called from its figure: six or eight of those long necks thus filled are placed in each side of the furnace in a range built with iron bars, at about nine inches distance from each other, and closed at the sides with bricks, the upper arches are left open to put in and take out the pots: over the arches they lay large bars of iron, and then they cover all the top of the furnace with loam, the body of each long-neck lying exposed to the fire, and the neck without, to which the receivers of glass are well luted; the lute is made of good loam, some horse-dung, and a little colcothar. Tho' the two former will do pretty well, in case the latter is not to be had: The luting being well mixed and applied, they make a gentle charcoal fire under the pots for three hours, and then they increase it for three hours more, about the seventh hour they make a vehement hot fire for four hours, and fling in towards the end well dried billets of oak, of the length of the furnace, whose flame surrounds all the pots, and finishes the work: next day

* The *test* is a round iron ring, some are made oval, about two, three, or more inches deep, according to the largeness and the quantity of the silver to be refined. This ring is filled with wood-ashes well cleansed and pressed very close; at the top there is a cavity, commonly sunk with an iron ball for to contain the silver: Before the ashes are quite dry, you put a cloth over it with fine ashes of trotter bones, which you sift upon, thro' a fine hair sieve, then place it on a tile, in a wind furnace, cover it with a muffle, and make it red hot; when so done, then put in the silver to be refined. Vide plate II. fig. 1.

the

the receivers are carefully separated from the long-necks, and the *aqua fortis* taken care of, and put by for use as occasion serves.

To refine gold from silver by parting.

PUT three parts or more of silver to one part of gold into a crucible, give it a brisk fire, and when in fusion, granulate it; then, after you have dry'd the grains, put them into *aqua fortis*, wherein the silver will dissolve, and the gold will precipitate and settle at the bottom, in a powder. After the gold is settled, pour off the dissolution of silver, wash the gold powder with clean water, and sweeten it from all the sharpness of the *aqua fortis*. Then dry and melt it in a small crucible, with a little borax or saltpetre; and when in fusion, and looks of a bright colour, cast it into an ingot or mould you have for that purpose. See plate II. fig. 5.

To bring the solution of the silver into a body, pour it in a thick-bottom'd copper bowl, that is thorough clean; add to it ten times the quantity of clean water, and the whole will turn of a sky colour; fling a little salt into it, stir it about with a clean wooden stick, and the silver will precipitate to the bottom of the consistence of a thin paste. After it has settled for three hours or longer, pour off the water into another clean copper bowl, and add some warm water to the sediment, which will also turn to a sky colour, but paler than the first: repeat this till the water comes off clear, and the silver remains free from all sharpness or salt. Warm the first blue water in the bowl, fling a little salt into it, and the silver that remain'd will settle at the bottom. Pour off the water, dry the sediments, and then, after you have greas'd or wax'd your crucible, melt them therein with a little borax.

How to granulate silver in the best manner.

TAKE a twig or two of a birch-broom, with these stir the water, in which you design to granulate, in a circular motion, at the same time pour your silver with discretion into it, between the branches of the twigs; and the process will answer to your satisfaction.

Another method to separate gold from silver.

TAKE the silver which contains gold, granulate it, or else cast it into an ingot; then hammer it into thin plates, and cut them in little pieces, roll them up in scrolls, so as not only to convey them easily through the neck of the matrafs, but also to prevent the plates laying upon one another, which would hinder the operation. Then pour to one ounce of silver, two ounces of *aqua fortis*; stop your matrafs, yet so as to give it a little vent; place it over a coal fire, and let it leisurely advance to working and boiling; continue it thus until the silver is wholly dissolved, and the *aqua fortis* looks of a clear colour. If the silver contains any gold, you will see it settle at the bottom of the matrafs, in a blackish powder; but if there appears little or no black sediment, it is a sign the silver contains no gold.

Pour the silver-water from off the sediment very gently and carefully into a glass or pan, since there is in every drop a mixture of silver; but particularly take care of the black sediment, for that is the gold calx.

To this silver-water put ten times the quantity of rain or river-water, which is better than spring-water: and at the bottom of the pan put a red hot plate of copper, which will cause the silver to precipitate to the bottom, and by degrees to hang to the plate, so as to cover it.

On the black sediment pour about an inch high of clear water, which will, for the first or second time, turn whitish, because of the silver that remains therein; add this water to that in the glass, and continue pouring of water on the gold calx until it comes off clear; then put the gold calx into a small crucible, drain off the water and let it dry; melt it in the same crucible with a little borax, and you will have the purest gold.

To try whether there is any silver remaining in the water, sling a little salt in it, and let it stand all night to settle; if there is any, the water will turn turbid and muddy, but if there is no silver remaining, the salt will settle at the bottom of the glass, and the water remain clear. After it has settled 24 hours, or more, pour the clear water from off the top, and put the sediment, which is the silver calx, into a crucible which has been warmed and the inside waxed all over; in this
let

Fig. 1.

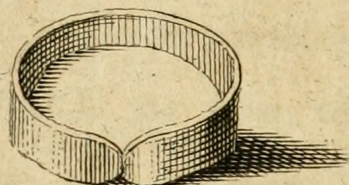


Fig. 2.

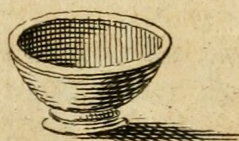


Fig. 3.

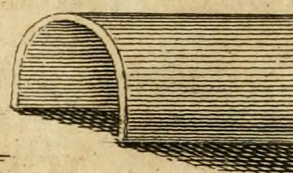
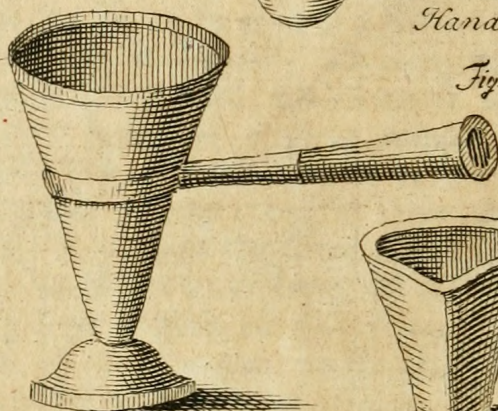


Fig. 2.



Fig. 4.



Hand Tongs

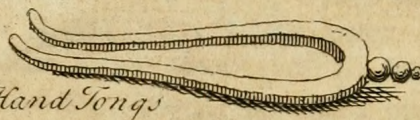
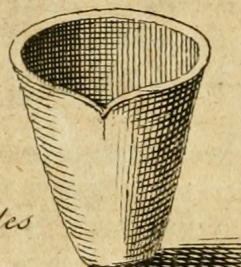
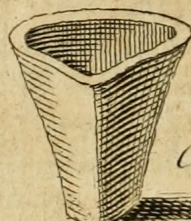


Fig. 5.



Crucibles

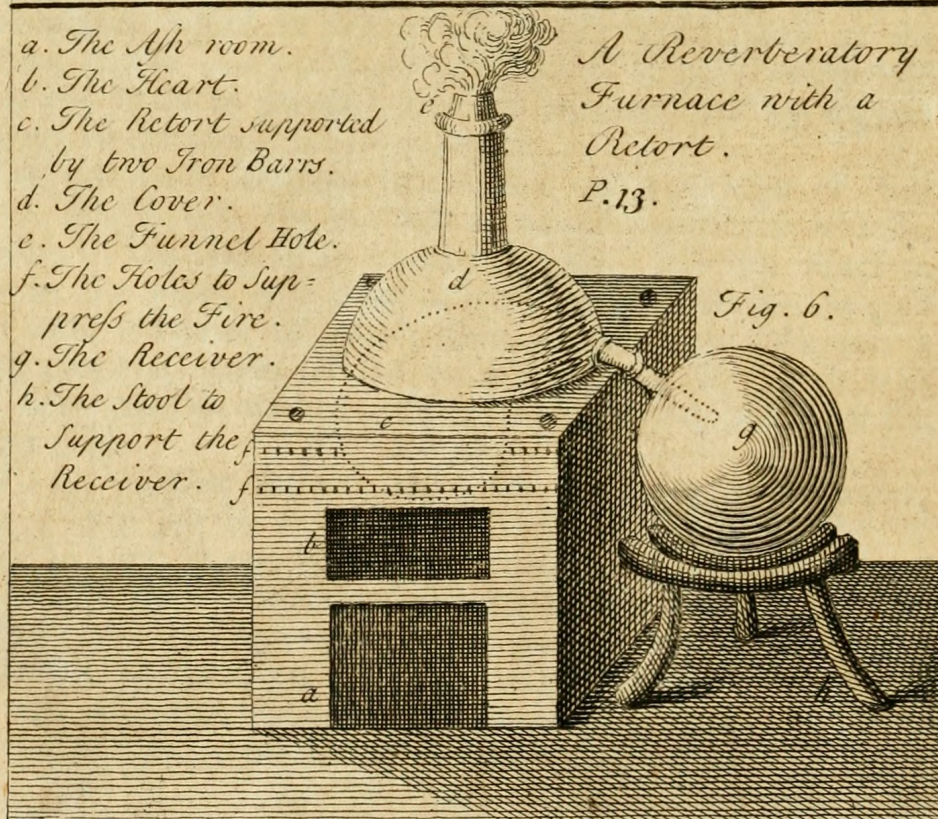


- a. The Ash room.
- b. The Heart.
- c. The Retort supported by two Iron Bars.
- d. The Cover.
- e. The Funnel Hole.
- f. The Holes to suppress the Fire.
- g. The Receiver.
- h. The Stool to support the Receiver.

A Reverberatory Furnace with a Retort.

P. 13.

Fig. 6.



Hulett Sculp

let the calx settle, then pour off the clear water; when the calx is dry, melt it as has been directed, and you will have the purest silver for use. This is the shortest manner of separating these metals.

To separate gold or silver from other metals.

TAKE your coppel *, and put it under a muffle †, which cover all over with live coals, adding dead ones to them, and by degrees augmenting the heat, till both the muffle and coppel are red hot. Then put, according to your quantity of gold or silver, a proportionable quantity of lead into the coppel, which is commonly four parts of lead to one part of gold or silver. When the lead is melted, and of a sparkling and fine quicksilver colour, then put your gold or silver upon it, and it will melt presently: give it a brisk fire, and the baser metals will mix and unite with the lead, but the gold or silver remain in the middle, clean and purified from all dross, which fixes itself to the sides like a scum; this you take off, preventing its entering into the pores of the coppel, and this is what is called *litharge*. Continue the fire till you observe no rising of fumes.

By these means gold and silver is separated or purified from dross and other metals and impurities.

* The *coppel* is made like an earthen cup, not glazed, but able to withstand the fire; this lined throughout with paste, made either of wood ashes, or the ashes of bones, mixed up to a mass with either strong beer, urine, or whites of eggs. The wood ashes are washed in several waters, till they have lost all their filth and salt, and the water comes off clear and sweet, as when first put on. The bone ashes lose their salt in the fire, and are commonly burnt of trotter-bones, or those of calves heads; some prefer fish bones before any other: the ashes, whichever are used, must be sifted through a fine hair sieve. After having prepared this paste or mass, the cup is lined all over the inside very smooth and neat, leaving only a cavity or a hollow in the middle, to hold the matter that is to be *coppelled*, and then it is set to dry. The size of these *coppels* are made to the quantity of the metal to be purified. See *plate II. fig. 2.*

† A *muffle* is made of one part of clay, mixed with one part of sand and two parts of horse dung: work up this, first in a square flat, with a rolling pin, to the thickness of a crown piece, and then bend it into an arch and let it dry. Some only use pipe-clay by itself. See *plate II. fig. 3.*

To refine gold by antimony.

TO one ounce of gold, take four ounces of antimony, melt the gold in a proportionable crucible; at the same time melt the antimony in another large crucible, and throw the gold into it, then make it red hot; when so, cast it into a brass cone *, but let the inside be a little warmed and greased with tallow before you use it; then with a piece of wood, or with a handle of a hammer, knock pretty hard and quick upon the rim, which promotes the gold's sinking to the bottom; when cold, turn it out of the cone, and you will see the *regulus*; beat it gently off with a hammer, and lay it by. Then take the *antimony*, put it into the same crucible, melt it as before, and when turned out, you will find a little *regulus*; if you think you have not all the gold, you may repeat it a third time. When this is done then separate the remaining *antimony* from the gold, thus: Take a pretty large crucible, put the *regulus* and a handful of *saltpetre* into it; then take another crucible fitted in the former, make a vent-hole in the bottom, and turn it upside down, so that the hole may be uppermost. When the wide ends of the crucibles fit well, take a lute, mix it with some pounded glass, and lute it well, let it dry very well before a fire, then take a brick-bat, put it in your melting-place, and lute your crucible upon it: this done, lay a little small fire about it; on that lay deal charcoal, to the top of the upper crucible, but take care the hole be not covered: as the heat of the fire augments, so the *saltpetre* goes off in strong fumes through the hole. When the fumes cease, give it a strong heat for an hour or less, according to the quantity; then take the crucible out of the fire, and let it cool; or else when you see the crucible turn black, you may quench it in a pail of water; knock off the bottom of the crucible, and you will find the gold refined; then take a clean proportionable crucible, put a little *borax* and the gold into it, melt and cast it into an ingot. This is the finest gold possible.

To prepare a crucible so as not to contract any gold, though it is for several hours in the greatest heat.

TAKE a good crucible, which will stand the fire, warm it a little, and smear or rub it over with a rind of bacon, both inside and outside; then put it in a warm

* See the figure of a cone. Plate II. fig. 4.

place

place to dry ; when dry repeat rubbing it over again as before, and let it dry : this you do for three or four times. This done warm your crucible again, and smear it, both out and inside, plentifully with soap, then put it to dry, and before you use it, put it on a charcoal fire, and the soap will burn in a flame, when it is burnt out, then you may use it for melting gold or silver, and it will attract nothing of these metals as your common crucible will.

A method of purifying gold, by way of cementation.

CEMENTATION is a singular and useful art, by which gold may be purified from the allay of any other metal ; and this is done by means of a moistened powder, which eats and consumes the impurer metals in it : but it is to be observed, that this cementation is only to be used where the gold has the predominancy ; otherwise if there should be more silver or other metal than gold, it is better to perform the separation with *aqua fortis*, as has been directed.

The cementing powders are prepared of such salts and ingredients as by their acrimony or sharpness consume the silver or copper.

To these are also added, * *æs ustum*, which gives the gold a fine colour ; also *blood-stone*, *tutia*, *crocus martis*, calcined *vitriol*, and several other things heighten the beauty of that metal.

Brick-dust is used in this cement, in order to receive the allay, whether it be silver or copper, or any other metal, from the ingredients that attract and separate them from the gold, which otherwise would adhere to the gold. I shall here set down a few receipts of such cements as have been tried with success.

* *Æs ustum* is prepared thus ; Stratify plates of copper with powdered sulphur in a large crucible, cover and lute it with a cover that has a hole in the middle, to give vent for the fumigation ; give it a strong fire in a wind-furnace, so long till you see no exhalation of vapours ; then take off your plates whilst hot, separate them, and when cold, beat them to a powder, which is the *æs ustum*.

TAKE

TAKE fine brick-dust one part, and fine pounded salt, one part, moisten and mix them with vinegar, and fill a crucible half full, then stratify plates of gold, or gold coin, with the aforesaid mixture or paste, and press it close down; repeat this as you have occasion, and put a thick layer at top; then cover and lute the crucible close, that nothing may evaporate: when this is done, fix your crucible upon a high brick, in the middle of the furnace, give it a violent heat for twelve hours, and the salt will eat and consume the impurities of the gold, and attract it into the brick-dust. *Or,*

TAKE in weight of saltpetre, of allum, and of sal-armoniac, one part; two parts of vitriol; four parts of salt; either parts of brick-dust, and mix them with vinegar; stratify this mixture and the gold, as before directed, in the crucible; cover and lute it well, and give it a violent fire for an hour or two, and let it cool of itself; but before it is quite cold, take out the gold, fling it into white-wine vinegar, and boil it therein; then brush it, and after you have done this, heat it red hot upon an iron plate. *Or,*

TAKE blood-stone two ounces, rust of iron, calcined vitriol, sal-armoniac, verdegrease, one ounce of each; *armenian bole, tutia*, saltpetre, allum, $\frac{1}{4}$ of an ounce of each; moisten this mixture three or four times with vinegar; let it dry between while, then grind it fine, and proceed as directed; give it a strong fire for three hours; which repeat three times.

To bring the silver out of the cementing powder or brick-dust, mix it with glass and granulated lead, let it melt together, put it to the test, and you will have the silver again which was in the gold.

To separate gold and silver out of the sweepings.

TAKE sweepings, put them into a pan well glazed, add a proportionable quantity of mercury to them, mix the dust and mercury with your hands well together, so long till you think the mercury has extracted all the gold and silver from the dust; then put the mass into a piece of wash-leather,

leather, and wring out the mercury, what remains in the leather will be like a paste; put that into an alembick, and drive the mercury from it into a dish with water, which put under the head to receive it; what remains put to the test, refine it with lead, and separate it with *aqua fortis*.

To separate the gold from gilded copper.

TAKE four ounces of yellow brimstone, two ounces of sal-armoniac, one ounce of saltpetre, half an ounce of borax, and grind them fine, with strong vinegar, to a paste; which lay thin over the gilded copper, give it a gentle heat until the paste is burned away and the copper looks black, then take it out, and with a knife, or other such instrument, scrape off the gold in a clean dish, and it will come off very easy.

Another method.

TAKE the root of *bertram*, cut it fine, pour one quart of strong white-wine vinegar upon it, put it into a boiling-pot, cover it with a lid, lute it well, and let it boil a little, then take it off the fire and let it cool. After this, take a copper cup, or any other thing that is gilded, Neal it well, quench it in that liquid, and the gold will fall off from the copper to the bottom, which wash, and then melt together in a crucible. Or,

TAKE fine sal-armoniac two parts, sulphur one part, grind them well together, anoint it with linseed oil, strew the powder upon it, hold the gilded piece to the fire over an earthen dish with water; strike it with an iron, and the gold will fall off into the dish. Or,

TAKE saltpetre and borax, one ounce of each, dissolve them in a little quantity of water; then Neal your copper, and quench it in this water; repeat this several times, and the gold will fall to the bottom.

To

To separate copper from silver, or any other allay.

TAKE half an ounce of verditer, or *Spanish green*; white vitriol and sulphur, one ounce of each; allum half an ounce; boil all together in vinegar, in a glass, put in your mixt silver; this will dissolve and extract the copper, and the silver remain whole.

To extract the silver out of a ring that is thick gilded, so as the gold may remain intire: a curious secret.

TAKE a silver ring that is thick gilded, make a little hole through the gold into the silver, then put the ring into spirit of niter in a warm place; it will extract the silver, and the gold will remain whole.

To make brittle gold malleable.

PUT gold into a crucible, and give it a brisk fire in a wind furnace, or before the bellows; when the gold is ready to melt, fling gently upon it some good, dry and clear saltpetre, which will presently flame, and promote the fusion of the gold the sooner, and the saltpetre will spread and cover the gold; then cast it into an ingot, which before has been warmed and anointed with wax. Or,

THE best way of all to make gold malleable, is this: Take human excrements, dry and calcine them in a crucible to a black powder; when the gold is in fusion, fling some of this powder upon it, and give it a brisk fire; when the powder is consumed, cast the gold into an ingot, and it will be fine and malleable: if you extract the salt from the black powder before you use it, it will still have a better effect, and that with a less quantity.

To make silver that is brittle, pliable.

TAKE one mark of silver, half an ounce of glass, one ounce of saltpetre, a quarter of an ounce of borax, half an ounce of *sal gemmæ*; put all this into a crucible, and cover it with a lesser one that has a vent-hole at the bottom, and lute it well;

well; then give it a brisk fire, and continue it so long till you think the silver is dissolved; then cover the crucible all over with live coals, except the vent-hole, and leave it to cool: take off the upper crucible, and you will find therein hanging all the impurities the silver contained, and which occasioned its hardness: then melt the silver again in a crucible, and throw into it half an ounce of tartar finely ground, and when in fusion cast it into an ingot, and you will have fine and malleable silver.

To give gold, silver, or other metals, a quick fusion.

TAKE calcined *Venetian* soap, borax, glass-gall, or *Venice* glass, an equal quantity, grind and mix it well together, this will cause a quick fusion. Or,

TAKE yellow amber, borax, glass-gall and soap, equal quantities, grind them together to a powder, and what you design to melt, let it be done with that composition.

To try whether granulated silver contains any gold.

TAKE some of those silver grains, and rub them on a touch-stone; then with the end of a feather let fall a drop or two of *aqua fortis* upon the strokes and let them continue upon it for a little while; if it contains gold, you will see some remains of the strokes; but if not the strokes will vanish.

To amalgamate gold, or to mix it with mercury, which is of use to gilders.

TAKE a pennyweight of fine gold, beat it into very thin small plates; heat them in a crucible red hot, then pour upon them 8 pennyweights of quicksilver, revived * from cinnabar;

* Reviving of quicksilver from cinnabar, is thus performed: Take a pound of artificial cinnabar, powder it, and mix it exactly with three pounds of quick lime, also powdered; put the mixture into

into cinnabar; stir the matter with a little iron rod, and when you see it begin to rise in fumes, which quickly happens, cast your mixture into an earthen pan filled with water, it will coagulate, and become tractable; wash it several times to take away its blackness; thus you have an *amalgama*; from which separate the mercury, which you will find is not united, by pressing it between your fingers, after you have wrapt it up in a linen cloth.

Gilding upon silver, brass, copper, and iron.

IF you would gild silver, take of the aforesaid *amalgama*, and with it rub that which you design to gild close every where, that it may receive gold all over, then hold it over a charcoal fire, or lay it upon it, and it will cause the quicksilver to fly away, after which you may heighten the colour with gilding wax, as shall be directed.

A particular secret to gild silver to the greatest perfection.

TAKE *crocus veneris* * and vinegar, add to them quicksilver, boil them together, till they come to the consistence of a paste; with this quicken or anoint the silver you intend to gild, and wherever you quicken, it will turn of a reddish gold colour, which doth not happen when done with quicksilver only, for then it looks white: this is a curious secret; you may gild upon this paste with leaf-gold,

into an earthen pot, or glass retort, whose third part, at least, remains empty, place it into a reverberatory furnace, and after having fitted to it a receiver filled with water, let it rest twenty-four hours at least, stroke your fire by degrees, and at last encrease it to the height, and the mercury will run in drops into the receiver; continue the fire until no more will come: the operation is commonly at an end in six or seven hours: pour the water out of the receiver, and having washed the mercury to cleanse it from the little portion of earth it might carry along with it, dry it with linen or the crums of bread, and keep it for use. See *plate II. fig. 6.*

* Take the slips of copper, and quench them in urine, repeat this until it easily pulverizes. The powder you will find at the bottom of the urine, which preserve for use.

which

which otherwise would require to be ground; it makes the gilding look rich, and of an high colour.

Another advantageous manner of gilding on silver.

TAKE tartar one part, salt two parts, pour water upon them and add some steel filings, boil the silver therein until it becomes reddish, and this will require only the third part of what gold you would otherwise use.

A particular method of gilding, which may be done in a moment, better than with quicksilver.

TAKE the finest gold, dissolve it in *aqua regis* † which has been prepared with salt, let the *aqua regis* be evaporated to half the quantity, then put the glass into a damp cellar, on sand, and the gold will over night shoot into crystals, which take out, and let them dissolve again in distilled vinegar; put it again upon the fire, and let the half thereof evaporate, then put the glass again in the cellar, as before, in moist sand, and over night the gold will shoot into crystals. Dissolve these in rain water, and evaporate that to half the quantity, and again it will shoot into crystals; when this is done take the crystalline gold, grind it to powder with a knife, put that powder into the white of an hard-boiled egg, after the yolk has been taken out; set it in a cool and damp place, and over night it will dissolve into an oil: and what silver you anoint with it, though ever so thin, drying it gently, you will find the gilding of a perfectly high and fine colour.

† The preparation of this *aqua regis* only differs from the following receipt, in using of salt instead of *sal-armoniac*; the usual way of making *aqua regis*, according to Lemery, is thus:

Powder four ounces of *sal-armoniac*, and put it into a matrafs or other glass vessel of a good bigness, pour upon it sixteen ounces of spirit of nitre, place the vessel in sand a little warm, until the *sal-armoniac* is all dissolved, then pour the dissolution into a bottle, and stop it with wax. This is the right *aqua-regis*.

Gilding

Gilding after the Grecian manner.

TAKE mercury-sublimate * and clear sal-armoniac, of each one ounce, make a solution thereof in *aqua fortis*, then dissolve it in fine gold, which is beaten very thin; let this solution evaporate over a coal fire until it becomes an oil; then dip in it a silver wire; if it comes out black, and by re-heating it in the fire, turns out gilded, it is right, and fit to be used for gilding any sort of silver.

The true Italian gilding.

TAKE common vitriol four ounces, allum two ounces, white vitriol one ounce, white lead one ounce, salt two handfuls, river water one quart, let it boil to half the quantity, and let it stand until it settles and looks clear, then it is fit for use.

To deaden quicksilver for gilding.

TAKE clear quicksilver, which is free from any mixture of lead, put it into a matrafs, and fling into it a handful of fine white salt, shake it well together and let it stand for two days, then pour upon it strong vinegar, let it rest a day, and you will find a good quicksilver for gilding, and cheap.

* Mercury sublimate, or sublimate corrosive, is a mercury that is impregnated with acids, and by fire is raised to the top of the matrafs, or other vessel.

Put one pound of mercury revived from cinnabar, into a matrafs, pour on it eighteen ounces of spirit of nitre, set it on a warm sand, and let it stand until all is dissolved; this dissolution put into a glass vessel, or earthen pan, set it on warm sand to evaporate all the moisture, the remains will be a white mass, which beat to powder in a glass mortar, and mix with one pound of white calcined vitriol, and as much of depurated salt; put this mixture into a matrafs, so as to leave two thirds empty; place it in sand, give it first a gentle warmth for three hours, then augment the heat with laying on more coals, and a sublimate will rise to the top of the matrafs; the operation will require six hours time; when the matrafs is cold, break it, but take care to avoid a kind of light powder that flies in the air when the matter is stirred. You will have one pound and above of very good sublimate-corrosive.

To

To boil silver white.

FIRST neal your silver on a charcoal fire, until it becomes a little reddish: then, having boiled it with an equal quantity of salt and tartar powdered in a copper, with water, for a quarter of an hour, take it out and scratch-brush it in clean water; then take good tartar, tie it up close in a paper, put it in the fire so long until it has done burning and smoaking; grind it to a fine powder, mix it with clean water into a paste, and with it rub over your silver; this done, neal it again, and quench it in cold water, brush what remains black upon it with an hair brush, and boil it for two minutes in tartar water, then rince in it clean water, and, after you have wiped it with a dry rag, your work will be done.

A gold powder.

TAKE leaf-gold, or any other thin beaten gold, to the quantity of a penny-weight, or as much as you please, dissolve it in twice its weight of *aqua regis*. Let half the solution evaporate in a sand heat, then take dried linen rags, soak them in the remaining liquid, dry them by a gentle heat, and burn them on a slow fire in a crucible, the powder whereof will remain at the bottom, and be of a yellowish colour; and with this the gilding is performed.

Another for cold gilding.

TAKE half a pound of *aqua fortis*, put into it two ounces of sal-armoniac, finely pulverised and white, let it dissolve over a fire, and then filtrate it through a paper; put it into a matrafs, with as much fine beaten gold as will weigh two penny-weights; set it on a slow fire, in order to dissolve the gold into the *aqua regis*. When this is done, add to it two ounces of powdered *sal-gemmæ*, fine and clear, and let it dissolve upon the fire; then take fine clean linen rags, each about $\frac{1}{4}$ of an ounce in weight, dip them into that liquid until all the solution is soaked, and having dried them, burn them to a powder, which preserve for use. When you

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gild

Gild any thing with this powder, let the metal you design to gild be boiled and scraped, that it may be clean and fresh; wet a piece of cork with spittle or water, and with it take up some of the powder, rubbing the places of the metal you are about to gild until it is yellow, after which brush and polish it. You may use, instead of cork, a soft leather sewed or tied to the round end of a little stick. Or,

TAKE of the finest gold the quantity of two penny-weights, and dissolve it in *aqua regis*; add to this solution the weight of the gold of refined saltpetre, let that also dissolve; this done, dip a fine little linen rag until it has soaked up all, dry it gently and burn it to powder. With this powder and fresh water gild your silver, by rubbing it with a cork, or a leather, fastened to the nob end of a stick.

Another powder to gild withal.

TAKE refined gold, beat it very thin, make it into little rolls, fling it into *aqua regis*, hold it in a matrafs over a slow fire, until all the gold is dissolved, and the solution is turned of a yellow colour, then throw into it some pulverised crystalline saltpetre, by little and little, as much as it will consume; then take some long narrow slips of old fine linen, draw them through that liquid, and when they are thorough wet, hang them in the air to dry, in a glass bowl, or a piece of a broken bottle, and, when thoroughly dry, light them with a coal, and let them thus, without flaming, consume to ashes. With these ashes you may gild, rubbing it on the silver with a piece of cork. Or,

TAKE a penny-weight of gold, with an equal weight of saltpetre, as also of *sal-armoniac*, all which put into a matrafs with three quarts of *aqua fortis*; then put the gold nealing hot into it, and as soon as the gold is dissolved, take some dry linen rags, dip them therein, dry and burn them at a candle to tinder, which preserve for use, as has been said above.

A quickening

A quickening water.

TAKE one ounce of quicksilver, and as much *aqua fortis*, let them be put together into a glass, and after the quicksilver is dissolved, add to it five ounces of fresh water; warm it, and it will be fit to gild withal. *Or*,

TAKE one ounce of *aqua fortis*, put it into a matrafs, add to it a quarter of an ounce of mercury, let this dissolve; then take fresh river water, and mix it with that in the glass, and make it lukewarm; then let it stand close shut up, and you will have a good quickening water for gilding.

Another water-gilding upon silver.

TAKE copper-flakes, pour strong vinegar thereon, add to it allum and salt, equal quantities of both, set them on a fire, and when the vinegar is boiled to a fourth part, throw into it what metal you design to gild, and it will acquire a copper colour. If you continue boiling it, it will change into a fine gold colour. This is a fine secret for goldsmiths to gild silver, for the boiling it in that liquid, gives the gilding a high and rich colour.

A water which will give silver a gold colour.

TAKE brimstone and saltpetre, of each an equal quantity; grind it together very fine, and put it into an unglazed vessel, cover and lute it well; then set it over a slow fire for twenty-four hours, and what you find remaining, put into a strong crucible, and let it dissolve; then put it into a vial, and whatever silver you anoint therewith, it will give it a gold colour. *Or*,

TAKE sulphur half a pound, saltpetre three quarters of a pound, mix both together, and grind it fine, and proceed as above, or set it twenty-four hours on hot ashes; then take it out and grind it again. Of this powder take one third, mix it up with three quarters of running water, mix it well, and you will have a red water like blood, which will tinge

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silver,

silver, copper, or brass of a fine gold colour, after it has lain therein ten days.

A method to work a cup, one side gold and the other silver.

TAKE a piece of fine silver, form it into a flat square, and file it rough all over on one side; raise also with a graver little points upon it. Then take a piece of gold in proportion to what thickness you would have it; form it exactly to the dimensions of the silver, in a flat square; heat both the gold and the silver red hot; then lay them quick on one another, and with a wooden hammer strike them gently together: when thus you have united these two metals, you may make thereof what you please, one side will be silver and the other gold.

To adorn gold, silver, or brass, with embellishments of glass.

TAKE fine pulverized Venice glass, of what colour you please, grind it upon a stone, temper it with oil, then put it into a circle of clear charcoal fire to melt, it will look fine and beautiful, especially if the ornaments are well designed.

Of heightening the Colour of GOLD and GILDED WORKS.

GOLD, as well as gilded silver, want considerably of that lustre and brightness they appear in at goldsmiths shops; for before this they undergo several operations, and are heightened by gilding wax, colouring and helling; each of which shall be separately explained under the following heads.

Gilding wax, used for gold, or gilded work.

TAKE four ounces of clear wax, $\frac{3}{4}$ of an ounce of verditer, half an ounce of copper flakes, $\frac{1}{2}$ an ounce of red chalk, $\frac{1}{4}$ an ounce of allum; melt the wax, and put the

the other things, finely powdered, into it, and stir it well together; let it cool, and form thereof round sticks like sealing-wax: When you have occasion to make use of it, first heat your gold, and then rub it over with this wax; then neal it, and draw it nimbly through boiling hot water and tartar, and it will give the gold a deep colour.

To give gold a high colour.

TAKE clear wax one pound, crocus veneris an ounce and a half, sal-armoniac, fine terra-verd and allum, one ounce of each, red chalk half an ounce and one dram, crocus martis and tutia of each half an ounce, salt-petre, or petre-salt, two drams, mix all these ingredients together, and after you have pulverised them, stir and mix it well with melted wax, which being spread over the gilded work, and then nealed, as has been observed before, it will give the gold a surprizing beauty. Or,

TAKE two pounds of wax, one pound of red chalk, one pound of white vitriol, and four ounces of *æs ustum*. Or,

TAKE eight ounces of clear wax, one ounce and a half of *terra vert*, one ounce of *æs ustum*, one ounce of red chalk, and half an ounce of allum; dissolve the wax, and put these ingredients into it; let it cool, then form it into sticks like sealing wax; with this, after you have heated your gilded metal, rub it over; then burn it off, and it will give the gold a deep colour.

Nuremberg gilding wax.

TAKE two pound of wax, two pound and one ounce of red chalk, one ounce of vitriol, half an ounce of *æs ustum*, three ounces of verdegrease, half an ounce of borax. Or,

TAKE four pounds of clear wax, one pound eight ounces of red chalk, one pound eight ounces of white vitriol, 15 ounces of verdegrease, three ounces of *Venice borax*, 15 ounces

ounces of *æs uſum*, beat them fine, mix them together, and when the wax is melted, ſtir it until you perceive it to cool; then put in the ingredients, and ſtir them well together, and when cold, form them into ſticks like ſealing-wax.

To diſtinguiſh cinnabar from white copper.

TAKE cinnabar and ſulphur, mixed together, ſtrew it upon the metal, light it, and when it burns you will ſee whether it is copper or ſilver.

To make all metals malleable.

TAKE maſtick, frankincenſe, myrrh, borax of Venice, of each half an ounce, pulverize and mix them together, and when your metal is melted, ſling in it ſome of the powder, and you will be ſurpriſed at the effect thereof.

How to quicken braſs for gilding.

DISSOLVE ſal-armoniac in white-wine vinegar, and with it anoint your work; this will cauſe it to receive the mercury.

Of ſeveral GOLD COLOURS, whereby GOLD, or GILDED WORK, after it has been heightened with GILDING-WAX, receives its proper Colour.

A ſilver gold colour, or a colour for gilded ſilver.

TAKE one ounce of verdegreaſe, one ounce of ſaltpetre, one ounce of vitriol, half an ounce of ſal-armoniac, half an ounce of borax, grind them fine; boil them in half a pint of urine to half the quantity; then with a brush dipt in this liquid, brush over your gilded work; put it upon a clear charcoal fire, and when you ſee it turn black, take it off the fire and quench it in urine.

A

A green gold colour.

TAKE two ounces of faltpetre, two ounces of vitriol, two ounces of verdegrease, and one ounce of fal-armoniac; mix and grind them with vinegar. *Or,*

TAKE four ounces of verdegrease, four ounces of fal-armoniac, two ounces of vitriol, two ounces of *æs uftum*, one ounce of faltpetre, grind them with vinegar and colour your gold therewith.

A French gold colour.

TAKE four ounces of falt, two ounces of allum, two ounces of fal-armoniac, two ounces of *æs uftum*, one ounce of faltpetre, and grind them with vinegar. *Or,*

TAKE four ounces of fal-armoniac, four ounces of verdegrease, two ounces of faltpetre, one ounce and an half of clean copper-flakes; grind them with vinegar.

A fine gold colour.

TAKE melted faltpetre, and black vitriol, an equal quantity of each, let them boil half away in a clean pipkin.

Another gold colour.

TAKE one ounce of verdegrease, one ounce of fal-armoniac, one ounce of red chalk, one ounce of fine falt, grind all together and boil them with vinegar. *Or,*

TAKE one ounce of faltpetre, one ounce of verdegrease, one ounce of vitriol, one ounce of fal-armoniac, grind each ingredient separately in a clean mortar; then mix and put them in a clean pan with water, and boil them for almost half an hour.

A green gold colour.

TAKE four ounces of fal-armoniac, four ounces of verdegrease, two grains of faltpetre, and grind them in vinegar.

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A white

A white colour for gold.

TAKE two ounces of saltpetre, one ounce of allum, one ounce of salt; pulverize and mix them well together; then take a piece of a broken muffle or crucible, put it in the fire; and let it be red hot; wet the work you design to colour, and roll it in the powder, then put it on the red hot piece of muffle, and the colour will boil up; when it melts, turn the piece of work with your tongs about, and when the colour is quite fluid, and yellows, take it out, and lay it upon a clean brick or anvil until it is cold. Then take an unglazed pot, or else a large crucible; fill it almost up with clean water, put into it a handful of salt, and the quantity of a filbert of ground tartar, and six or eight drops of *aqua fortis*; let that boil, then put your work into it, and boil it until the dross of the white colour is taken clean off, then scratch-brush it.

To colour an old gold chain as though it were new.

TAKE urine, dissolve therein sal-armoniac, boil in this the gold chain, and it will have a fine colour.

A green colour for gold chains.

TAKE four ounces of sal-armoniac, four ounces of verdgrease, one ounce and a half of saltpetre, half an ounce of white vitriol, make a powder thereof, mix it with vinegar, and boil your chain in it.

To give gold a high and fine colour.

TAKE red calcined vitriol three ounces, sal-armoniac two ounces, and verdgrease one ounce: grind them together, and keep them dry. When you would colour your gold, moisten it, and strew this powder over it, Neal it often, and quench it in pump-water.

Another fine colour for gold.

TAKE verdgrease, sal-armoniac, saltpetre and vitriol, an equal quantity of each, grind them well together; pour vinegar upon them, grind them again, as painters do their colours, and let them dry; then moisten, grind, and

and dry them again; repeat this for several times: then lay up your powder carefully, and when you would colour gold, wet it with urine, rub it with a brush, then fling the powder upon it, lay it on red hot coals, and it will turn black, then quench it in urine, and rub it with a wire brush; in this manner you may proceed with the other colours.

To bring pale gold to an high colour.

TAKE verdegrease, pour vinegar upon it, stir it well, anoint your gold therewith, heat it in the fire, and quench it in urine.

To make silver yellow throughout, and to give it the colour of gold.

TAKE common *aqua fortis*, dissolve therein as much silver as you please; if you have eight ounces, take four ounces of *hepatic aloes*, six ounces of *gurgumi*, two ounces of prepared tutty, that has been several times quenched in urine; put these to the solution of the silver, and they will dissolve, and rise up in the glass like a sponge; the glass must be large, to prevent the running over; then draw it off, and you will have ten ounces of silver, which is as yellow as gold.

N. B. These two ounces, increased in the weight of the silver, will not stand the test, but be lost when melted down with lead.

A water to give any metal a gold colour.

TAKE fine sulphur and pulverize it, then boil some stale spring or rain water, pour it hot upon the powder, and stir it well together; boil it and put into it one ounce of dragon's blood, and after it is well boiled, take it off and filter it through a fine cloth: put this water into a matrafs, after you have put in what you design to colour; close it well and boil it, and the metal will be of a fine gold colour.

Ano-

Another water wherewith one may tinge any metal of a gold colour; a curious secret.

TAKE *hepatic aloes*, salt-petre, and Roman vitriol, each equal quantities, distil them with water in an alembic, till all the spirits are extracted; it will at last yield a yellowish water, which will tinge any sort of metal of a gold colour.

To colour gold.

TAKE a lock of human hair, of about a finger thick, lay it on live coals, and hold the gold with a pair of tongs over it, to receive the fumes thereof.

To give gold a fine and high colour.

TAKE one ounce of sal-armoniac, two ounces of copper flakes, one ounce of distill'd verdegrease; grind all well together, put the mixture into a matraiss, pour upon it one quart of good distill'd white-wine vinegar: let it thus dry and boil away; then grind it fine, strew it on a glass plate, and set it in a cellar, where it will turn into an oil: this is again to be gently coagulated, then ground and mix'd with sublimate mercury; put half an ounce of it, wrapt up in bees wax, into the quantity of a pound of gold that is in fusion, and it will give it a high and fine colour.

To give gilded work a fine colour.

TAKE clean salt and brimstone, boil them together with water in an egg-shell; after taking away the inside film; take care you don't give too much fire to burn the egg-shell; with this liquid wipe over your gilding, and it will make it of a much brighter colour than it was before. *Or,*

TAKE powder of sulphur, and bruised garlick, boil these in urine, neal your gold, quench it therein, and it will give it a fine colour.

To

To brighten spots in gilaing.

TAKE allum, boil it in clear water, put your work in-
to it: this will restore the colour again, and remove
the spots.

*To give old silver lace or trimmings their beauty and colour, as
if they were new.*

TAKE powder of alabafter, put it dry into a pipkin,
and let it boil as long as it can; then take it off the fire,
and when cold, lay your lace upon a cloth, and with a comb-
brush, take up some of that powder, and rub therewith both
sides, till it is as bright as you would have it, afterwards po-
lish it with a smooth stone. *Or,*

TAKE ox-gall, and the gall of a large jack, and some
water, mix it together, and with it rub your gold or
silver, and you will see the colour change to your liking.

Of the HELL, or HELLING of GOLD.

This is the finishing stroke of either gold or gilded
work, and is performed after it has undegone the
operations with the gilding wax and gold colours,
as has been shewn in the foregoing articles. The
following are the different receipts of different
masters. The ingenious and judicious will by ex-
periments soon discover which of them is best, and
make his choice of such as he approves.

To hell gold, or gilded work.

TAKE two ounces of tartar, two ounces of sulphur
and four ounces of salt; boil this in half water, and
half urine, dip your gold or gilded work into it, and it will
give it a fine lustre. *Or,*

TAKE

TAKE eight ounces of salt, two ounces of tartar, two ounces of sulphur, two ounces of *cap. mort.* half an ounce of allum; if you boil this in water and urine, and draw your work through, it will answer your expectation. *Or,*

TAKE eight ounces of sulphur, eight ounces of allum, eight ounces of yellow arsenick, 16 ounces of tartar, 16 ounces of salt; boil them in water and urine. *Or,*

TAKE three ounces of sulphur, one ounce of allum, one ounce of arsenick, half an ounce of *gurgumi*, and half a grain of antimony, grind them very fine together; then boil them in urine and water, and stir the ingredients gently together; boil the mixture a little, put the gilded plate into it, and boil it till the colour is bright. *Or,*

TAKE eight ounces of yellow arsenick, 16 ounces of sulphur, 16 ounces of tartar, 16 ounces of burnt allum, three ounces and a half of salt; boil the mixture in urine and water. *Or,*

TAKE sifted ashes and antimony finely pulveriz'd, with these make a lee, and with a brush rub over the gilded silver. *Or,*

TAKE one ounce of white tartar, one ounce of green sulphur nine ounces of salt: grind them together like flower; then take a copper sauce-pan with fresh water, and let the water boil: put into it one grain of crude yellow arsenick; take of the ground ingredients three spoonfuls, and let it boil; after that, you may draw your work through it, and make it as high as you will, and it will come out clear and with a fine lustre.

How to take off the gold from gilded silver tankards or cups.

TO take off the gold from such plate, take sal-armoniac one part, salt-petre a half part, grind them both to a powder, wipe over the gilded part with oil, strew the powder

der upon it, and lay your plate into the fire to heat it well; then take it out; hold your plate over an earthen dish, in one hand, and with the other beat it with an iron, and the powder will fall into the dish, together with the gold, which you may separate in the manner as has been directed.

Another method.

PUT quicksilver in an earthen dish, heat it lukewarm; in this turn your silver cup or other utensil, and the gold will separate from the silver, and join the quicksilver; when you see the gold all come off the plate, take it out, pour the quicksilver with the gold, after it is cold, into another dish, and if any place still retains some gold, repeat it, till you perceive no more upon it; then strain the quicksilver thro' a leather; what remains put into a retort *, and on hot sand or ashes force the rest of the mercury from it into a receiver with water, and what is left melt together, and refine the gold as has been taught before.

An approved method to take off the gilding from silver.

FIRST take a glass or a glazed utensil, with aqua fortis, the quantity whereof must be according to the bigness of your work; take no more than half $\frac{1}{4}$ of an ounce of sal-armoniac to one ounce of aqua fortis; beat your sal-armoniac fine; put it into the aqua fortis, and set it over the fire, till it grows warm; and when you perceive the sal-armoniac to work, then put in the gilded silver, and when you observe your work to become of a black colour, then the gold is taken off of it; if there is a pretty large quantity of work, let it lie for half an hour or an hour before you take it out, which you must do with a pair of wooden plyers; when it is taken out, put it into clean water, then Neal it, and afterwards boil it with tartar; repeat this for three times successively, and your silver will look fresh and new.

* *Vid. plate II. fig. 6.* The neck, through which the mercury is convey'd, must be half way in the water, that is in the receiver.

How

How to get the gold out of aqua fortis.

TAKE a copper bowl or cup, put into it a glass full of water, then pour in the aqua fortis which contains gold, in order to sweeten it a little; then add to it $\frac{1}{4}$ of an ounce of Venice borax, and boil it up: let it stand all night, in the morning pour it off gently, and the gold will be settled at the bottom: dry it by degrees, and when dry, put a little borax to it, and melt it.

To give silver utensils a lustre.

Dissolve allum in a strong lee, scum it carefully; then mix it up with soap, and wash your silver utensils therewith, with a linen rag.

To separate gold from gilded silver, by cementation.

TAKE red calcined * vitriol or *colcothar* one part, salt one part, also red lead half a part, pulverize and mix them all well together; with this mixed powder cover your gilded silver all over in an earthen pan, put it into a furnace, and give it a slow fire, to prevent the melting of the silver: the powder will attract the gold, which you may reduce by melting it with lead, and by separating it in the copel.

* The calcination of vitriol is perform'd thus: Put what quantity you please of green vitriol into an earthen pot, unglazed; set the pot over the fire, and the vitriol will dissolve into water; boil it till the moisture is consumed, or the matter turns into a greyish mass, drawing towards white; this is called white calcined vitriol. If you calcine this white vitriol a good while over a strong fire, it will turn as red as blood. This is call'd *colcothar*.

Of

Of several sorts of SOLDER for GOLD and SILVER.

Filings-solder for silver chain-work.

MELT three parts of fine silver and one part of brass; when in fusion, fling into it a little quantity of yellow arsenic. Or,

TAKE one part of yellow arsenic, and one part of copper, melt and granulize it: of this take one part, and of fine silver four parts; melt them together; cast them into an ingot, and when cold file it to a fine dust.

A solder for silver.

MELT two parts of silver, then put to it one part of thin beaten brass or tinsel; but don't keep it too long in fusion, lest the brass should fly away in fumes.

Another, for coarse silver.

FOUR ounces of silver; three ounces of brass, $\frac{1}{4}$ of an ounce of arsenic, melt them together, and pour them out quick.

Another silver solder.

MELT two ounces of silver, one ounce of tinsel, add to it half an ounce of white arsenic, pour it out quick, and it is a very good solder. Or,

MELT one ounce of fine silver, one ounce of thin brass; when both are well melted together, then fling one ounce of white arsenic upon it, let it melt, stir it well together, and pour it out quickly.

Of good solder for gold.

MELT copper and fine silver, of each one part, fine gold two parts. Or,

TAKE

TAKE one penny-weight of the same gold your work is of, and alloy it with three grains of copper, and three grains of silver.

The Manner and Way of Soldering GOLD or SILVER.

BEAT the folder thin, and cut it into little bits, or pallions; then take the work which is to be soldered, join it together with fine wire, wet the joinings with a pencil with water, mixed up with borax; then lay the bits or pallions of folder upon it, and strew some powdered borax over; lay the work, if it be a button or some other small thing, upon a large coal, and blow with your blowing instrument, through a large lamp flame upon it, for to melt it.

After this boil the work either in allum-water, or else in *aqua fortis*, to clear it from the borax, and dry it on a charcoal fire; then file or turn it; if it be silver, boil it white in the following manner:

Take the work, lay it on a clear fire, and when red hot, take it out, and put it by to cool; in the mean while set a copper-pan not tinned, with water upon the fire, into which put one part of fine salt, and one part of tartar; this boil together, yet not too fiercely, to prevent its boiling over; after it is well boiled, lay the work, when it is a little cold, into it, and let it boil about six minutes; then take it off the fire, take out the work, and put it immediately into clean water, take it out and scratch it well with a wire brush, to clear it of the coat; then repeat this work over again; Neal it once more, boil it in tartar and salt, and proceed as before; then take black burnt tartar, mix it with a little water into a paste, with which rub over the work; then Neal it on a clear coal fire; take it out, and brush the work well of the burnt tartar in clean water; put it once more in the tartar-water in which it was boiled, and let it boil four minutes, then wash it in cold water, and dry it with a clean rag, it will be of a white and beautiful pearl colour.

How

To solder a ring set with stones.

TAKE a large charcoal, put two or three penny-weights of silver upon it, melt it with your blowing instrument and the lamp; then after you have clap'd a thin pallion of silver folder betwixt the opening of the ring, dip it into it; but as soon as you see the pallion run, take off your ring, or else the silver will devour it.

Borax for soldering.

TAKE the best hard *Venice* soap, scrape it as thin as possible, let it dry between two papers in the air; then rub it to a powder, put it into an unglazed pipkin, set it on a gentle coal fire, and let it by degrees fumigate until it has no moister at all, then it is right; this borax you may use for all manner of work, and it will do better than the *Venice* borax.

To melt in a moment several sorts of metals, over a table.

TAKE two ounces of saltpetre, tartar one ounce, sulphur half an ounce, beat it in a mortar to a powder; then take one ounce of filed metal, or fine pulverised oar, mix it well together, put it into a small crucible, or a hollowed charcoal, light it with a little splinter, and it will melt immediately.

Another manner of doing it.

TAKE one ounce of saltpetre, half an ounce of sulphur, $\frac{1}{4}$ of an ounce of gunpowder; grind them well together, and put half of this powder into a small crucible, or if you will into an egg-shell, then put a farthing, or six-pence, or any other metal upon it, and upon that put the other half of the powder, press it down with your finger, then set it on a stone, light it, and it will melt immediately.

N. B. A gilded cup, or other plate, if anointed with salad oil, and this powder flung upon and lighted, takes off the gold, and melts it to a mass.

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To

To prepare aurum fulminans.

TAKE gold that is refined with antimony, beat it into thin plates, put it into a phial or matrafs, pour *aqua regis* upon it; then set the phial, or matrafs, upon a sand-heat until the *aqua regis* has dissolved as much of the gold as it is able to contain, which you will know when you see the ebullition cease; pour your solution by inclination into another glass, and if you observe any gold remain in the matrafs, dissolve it, as before, with a little fresh *aqua regis*; mix your dissolution, and pour on it six times as much common water; afterwards drop into this mixture, by degrees, the volatile spirit of sal-armoniac, or oil of tartar, and you will see the gold precipitate to the bottom of the glass; let it rest a good while for the gold to settle, then pour off the water by inclination, wash your powder with warm water until it grows insipid, dry it to the consistence of a paste, then form it into little round corns, the bigness of hemp-seed, dry them by the sun; if you put one of them into the fire it will fly about with a terrible noise and great violence.

To make aurum sophisticum, or mimick gold.

TAKE fine distilled verdegrease eight ounces, crude *Alexandrian* tutty four ounces, borax twelve ounces, saltpetre one ounce and a half, pulverize and mix them all together, temper them with oil, with a wooden spatula, to the consistence of a paste, then put a *German* crucible into a wind-furnace, heat it red hot, and convey your mass into it with a wooden spatula, by little and little; when all is in, cover it; fill your furnace with coals all over the crucible; let it stand in a fierce fire and melt; let it cool of itself; then break the crucible, and you will find at the bottom, a fine *regulus* like gold, weighing about four ounces, out of which you may form and make what you please, it will be as malleable as real gold.

Another

Another.

TAKE fine and clear wire-copper four ounces; melt it; then fling into it one ounce of *speltar*, stir it well together with an iron spatula; blow the fire brisk, to bring it into fusion, but before you pour it out, put in some borax, and it will give it a peculiar beauty; then cast it into an ingot; out of this ingot you may draw wire for chains, and work it in what form or shape you please; and after you have filed it, and rubbed your work well with tripoly, then give it the finishing with a mixture of one grain of tripoly, and six grains of flower of sulphur, which put upon a piece of leather, rub your work as usual, and it will have a fine gold colour.

Another.

TAKE *speltar* one ounce, of the finest and softest copper two ounces; melt the copper in a crucible; when melted, fling into it *Venice* borax two grains, and sal-armoniac two grains, and lastly fling in the *speltar*: pour it into an ingot, and you will have a fine gold coloured metal.

To make a curious yellow mixed metal resembling gold, and which may be drawn into fine wire.

TAKE eight ounces of tartar, put it into a crucible and heat it by degrees; then take pulverised dry saltpetre, and fling on the red hot tartar, and it will melt into a yellow mass; take it from the fire, let it cool, then take clean copper, put it into fusion until it is like fair water, and fling to eight ounces of copper the above mass; give the crucible a strong reverberatory heat, until in fusion, then take the best *speltar*, or *gofslar*, *zink*, half an ounce, *tutty* and *Venice salacani* half an ounce, put it to the melted copper, and presently you will hear a crackling noise, and see a yellow fume and flame ascend; stir this copper, and the other ingredients, well together with an iron wire until it is burnt away; let it stand a little in the flux, and then, after you have rubbed your

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ingot

ingot with wax, pour it in, and it will be so pliable as to be drawn into wire, and of a high gold colour; you may work, form, finish, and colour it as you do other gold.

To convert copper into brass.

TAKE of copper what quantity you please, add to it a third part of powdered *lapis calaminaris*, put it together into a melting pot, and let it be in fusion for about an hour, then pour it out.

Another method to make a metal resembling gold.

TAKE fine copper filings one pound, fine saltpetre eight ounces, prepared tutty six ounces, borax six ounces, *hepatic aloes* four ounces; mix all well together, and incorporate the mixture with linseed oil into a mass; put it into a clean crucible, and cover it at top, a finger's height, with subtil pulverised *Venice* glass; lute it well; put it into a wind-furnace; fill the same with dead coals, then put live coals upon them, and light the fire from the top to go downwards; blow it for an hour, and give it a fierce fire; then let it cool of itself; take out the crucible, break the same, and you will find at the bottom a very fine *regulus* like gold; this melt again, and add to it one pound two ounces of *mercury sublimate*, and two ounces of prepared tutty, both clapped up in red sealing-wax; stir it well with a dry stick; then cast it into a mould, and make of it what you please. Or,

TAKE six ounces of distilled verdegrease, grind it fine in a marble mortar, beat eight ounces of prepared tutty, four ounces of saltpetre, and four ounces of borax into a coarse powder: moisten them with oil of turneps, and stir them in an earthen dish all together, until all is well mixed: then put a crucible into a wind-furnace, and when red hot, convey the said mixture into it with a wooden spatula; cover it, add more coals, and give a brisk and strong fire all over the crucible. In about half an hour put a little stick into it, and try whether the matter be dissolved, and in fusion like water; if so, then it is time to pour it out; but if you find still some matter

After remain, stir it about with your stick; cover it, and give it a brisk fire, until you find it is all dissolved: then pour it out into a mortar, or brass cone, and you will have a fine gold coloured regulus.

To silver copper or brass.

TAKE fine silver one ounce, sal-gemmæ and sal-armo-niac of each six ounces, glass-gall six ounces; beat the silver thin, and then put it into one ounce of aqua-fortis, let it dissolve; when dissolved fling a little salt into it, and the silver will settle like a white calx at the bottom; then pour off that water and put on fresh; repeat it, until the silver calx has lost all the flavour of the *aqua fortis*; dry this silver calx; then take the above ingredients and grind them well on a clean stone; when you have well ground them, mix and grind them and the silver calx together, with a little water, until the mixture is like a thick paste; put this up in a clean glass and when you would silver, take care that your metal be filed and brushed clean; rub it over with the above matter, and lay it on live coals; when it has done smoaking, scratch it well, and rub it over again with the silver matter; do this three times successively, and you will have a fine silvering.

Another way.

TAKE fine silver, dissolve it in *aqua fortis*; then add to it the same quantity of warm water as you had done of *aqua fortis*; take common salt, fling it into the mixed waters, and the silver will precipitate to the bottom like a powder; when settled, pour off the mixed water, and sweeten the silver calx by pouring fresh water to it, shifting it until all the sharpness is removed. Then drain off the water, and let the silver dry, of which take $\frac{1}{4}$ of an ounce, white calcined tartar one ounce, common salt half an ounce; then beat and mix them well together, and with *aqua fortis* grind them upon a stone; then let them dry, and you have a powder ready to silver withal. If you would silver either poor silver, copper, or brass, then rub the powder well in, after you have moistened it with water, with a piece of cork to

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your

your mind; then lay it on a coal fire until it is red hot; let it cool; then boil it in water with tartar and salt, and after it is boiled wash it in clean water.

What metals are most proper to incorporate with silver.

SILVER will easily mix and incorporate with fine clean copper, of each an equal quantity; for if you add more copper than silver to your composition, it loses the whiteness, and is not fit for to make any utensils therewith. All other metals are of a contrary nature to silver, as lead, tin, iron, brass, &c. therefore they are to be avoided.

To silver brass in fire.

TAKE calx of fine silver half an ounce, one ounce of sal-armoniac, three ounces of salt; mix and grind these well together. When you use it, grind and temper it together with water, and rub your brass therewith; Neal it brown; then quench it in water wherein tartar has been dissolved; scratch it, and finish your work by polishing it as you see requisite.

A powder to silver copper or brass withal, by rubbing it with one's finger.

DISSOLVE a little silver in *aqua fortis*, add to it as much tartar and sal-armoniac as to make it like a paste, whereof make little balls; dry and pulverise them; if you take some of this powder on your wetted thumb, and rub it upon the copper or brass, it will give it the colour of silver.

A silvering on copper.

DISSOLVE fine silver in *aqua fortis*; pour it upon pulverised tartar; and then draw your *aqua fortis* clear off, and there remains a black matter; with this rub your copper; then Neal it well and boil it in tartar and salt.

To silver copper or brass with boiling it.

TAKE three ounces of salt, twenty-six leaves of silver $\frac{1}{4}$ of an ounce of tartar, and half an ounce of allum; boil this in an earthen pipkin, and stir it well together; put what you design

design to silver into it; pour water upon it and let it boil; after it is well boiled, scratch-brush it; put it in again and boil it; then scratch it again, and repeat this so often until it is to your mind.

To boil brass like silver.

TAKE one part of the filings of good pewter; add to it one part of white tartar, and mix it together; then take an unglazed pipkin, put these two ingredients, and the brass (which before must be well scratched and cleaned) into it, and let it boil.

To silver copper, brass, steel, or iron, so as not to come off, except it is made red hot.

TAKE urine which is made in the morning, cover it and let it stand a whole month, and it will ferment; put it into a kettle or earthen pot, and let it boil; skim it, and when the third part is evaporated, take two pints of urine, one ounce of tartar, and an ounce of galiz-stone; put it in, and let it boil once up. This liquid keep clean, and if you would silver any metal, take brick-dust on a wet woollen rag, and rub therewith your iron or other metal, until it is clear and fine, and put it 24 hours in the prepared urine; afterwards dry it, and where you design to silver, rub it over with quicksilver; you must lay it on thin with an iron spatula that has also lain two hours in the urine; then rub it on with a soft woollen rag, and it is a fine bright silvering.

To silver all sorts of metals.

TAKE as much *aqua-fortis* as you think there is occasion for, put it in a glass, and set it on hot ashes; then put in your quantity of silver, which first has been beaten very thin, and cut into little shreds. When your silver is dissolved, take it off the ashes, and mix that liquid with as much white tartar as will make it like a paste: if you rub brass, copper, or any other metal, over with this, it will be like silver itself.

PART

P A R T II.

Choice Secrets for JEWELLERS, in ENAMELLING and the preparing of ENAMEL-COLOURS; the Art of Painting on enamelled Plates. Several curious Instructions how to make Artificial PEARLS; of DOUBLETS and FOYLES; and how to prepare and colour them. The Art of counterfeiting precious STONES, together with other rare Secrets.

THE foregoing part will, no doubt, give a sufficient idea, and direct the ingenious reader in the management of gold and silver, in all the different branches specified. We shall, in this second part, present him with several choice secrets, peculiarly relating to jewellers, and first shew that admirable branch

Of ENAMELLING.

To prepare the flux for enamel colours.

TAKE four ounces of red lead, one ounce of well washed and cleaned sea sand, melt them together, and put them in a cold ingot. Or,

Take pebble one part, prepared as shall be directed; mix one part thereof with five parts of red lead.

Another sort of flux, which is very soft.

TAKE one ounce of white lead, $\frac{1}{4}$ of an ounce of red lead, twelve grains of pebble; beat the pebbles red hot, and quench them in urine; repeat this until you can crumble them

them to an impalpable powder between your fingers; then beat them fine; put them with the ingredients into a clean crucible; lute it well, and when dry, give it a fierce fire for half an hour; or longer; then take it off the fire, and let it cool of itself; break the crucible afterwards, and you will find a regulus; which melt again in another clean crucible, and pour it into a clean ingot, or a bright brass weight scale, and then it will be fit for use; beating and grinding it in an agat mortar, to an impalpable powder. When you mix your colours therewith, temper as much as you have occasion for, with oil of spike.

A green colour.

TAKE of copperas, after nealing it, one part, four parts of flux. *Or,*

Take brass, and dissolve it in *aqua fortis*, then Neal it well, take of this one part, and three parts of flux. *Or,*

TAKE copper plates, and with a piece of pumice-stone rub it over with water, receive the water into a bason or dish, till you have wore it off pretty thin, then let it settle; pour off the water, and Neal the settling; then take thereof one part and three parts of flux; and this makes a good and fine green.

Dark green.

TAKE green enamel two parts, yellow smalt one eight part, and six parts of verditer.

Yellow colour.

TAKE fine king's yellow, Neal it in a crucible, one part yellow, and three parts flux.

A high yellow.

TAKE gold-yellow enamel, vitriol and flux; grind and temper them to your mind with oil of spike.

Brimstone

Brimstone colour.

TAKE calcined *Naples* yellow one part, three parts of burn'd lead yellow, and three parts of flux.

A black colour.

TAKE $\frac{3}{4}$ of black enamel, and one eighth of scales of iron or an enamel-plate; grind this with water in an agat mortar very fine; draw the water from it, and dry it upon hot plates; then grind it with oil of spike. Or,

TAKE *Hungarian* vitriol, boil it over a gentle fire, take borax, and melt it in a new crucible, three different times; take one part of vitriol, three parts of flux; grind these with oil of spike as quick as possible. Or,

TAKE magnesia, Neal it upon a tile; the blacker it comes off the fire the better; and take one part thereof with three parts of flux, ground with oil of spike.

A good red.

TAKE *Hungarian* vitriol, grind it fine, and dry it in the sun, then Neal it between two crucibles, well luted, so as to prevent the air's coming to it. Take thereof one part, and two parts and a half of flux; melt them together, and when you use them, grind them with oil of spike.

Another.

TAKE *Roman* vitriol, about the quantity of a walnut; grind it in a stone mortar, very fine; dry it, and then Neal it to a brown colour; take the heavy lumps, put them into a new glazed pipkin, and pour *aqua fortis* upon them; then wash the *aqua fortis* from them again, and let it evaporate; take afterwards one part thereof, and three parts of flux; grind it with oil of spike.

Another

Another good red.

TAKE brown red, or caput mortuum of *aqua fortis*, or Paris red, and a little flux; grind them fine with oil of spike. Or,

TAKE vitriol, let it boil up in a clean crucible, and when dry, pour a little *aqua fortis* and vinegar on it; Neal it well; after that wash it with clean water, till it has no taste; dry it over a fire; and when dry, Neal it again; then take of this one part, and three parts of flux.

Blue colours.

TAKE fine smalt, wash it well with clean water, as fine as possible; put a little flux to it, and grind it with oil of spike. Or,

TAKE ultramarine one part, flux four parts, grind them with oil of spike. Or,

SIX ounces of lead, four ounces of sand, two ounces of saffera, two quarts of pot-ashes, and two quarts of lead-salt.

Smalt may also be used without the principal powder, only ground with oil of spike.

Green.

TAKE verditer, and a little ground flux; grind them with oil of spike.

Grass green.

TAKE verditer, Neal it in a crucible, and take one part of it, and three parts and a half of flux.

Brown colours.

TAKE crocus martis one part, flux two parts, grind them with oil of spike.

Purple.

Purple colour.

TAKE one part crocus martis, one part smalt, and three parts flux. *Or,*

TAKE blood-stone, grind it with vinegar; when it is fine, wash it clean, and burn it over a candle on a thin plate,

Hair colour.

TAKE umber, Neal it in a crucible; then take one part thereof, and three parts of flux; grind them with oil of spike.

Fawn colour.

TAKE vitriol, glow it as hot as possibly you can; then take of it one part, and three parts flux.

Carnation colour.

TAKE yellow ochre, glow it in a crucible very hot, and after that let it cool, and beat it in an iron mortar, and if it is not of a fine colour, Neal it again; take of this one part, and three parts and a half of flux.

A steel red for enamel.

TAKE fine thin beaten plates of steel, cut them into small shreds; put them into a vial with *aqua fortis*, and when reduced to a calx over a slow fire, then Neal it; of this take one part, and three parts of flux.

Of

Of the Art of *Painting* on *Enamel*.

THE ancients that laboured in this noble art, were unacquainted with the beauties the moderns have discovered, particularly in the art of compounding colours for representing portraitures and history: the fine performances in those particulars are the admiration of every curious beholder. Besides their peculiar beauty and lustre, they have the pre-eminence to all other paintings, in that they are not subject to the injury of the air or weather, as most other paintings, either in oil or water colours, are; and unless they are rubbed or scratched with any thing harder than themselves, the colours will retain their beauty for ever, and be as fine and bright as when first done.

This curious art cannot be effected without fire, which always must be reverberatory, or in a furnace, so artfully contrived, that the fire may play all over the muffle that covers your work; but to explain this more fully, take the half of a large crucible, *viz.* one that is split down lengthways, but as thin as possible you can get; when your reverberatory is building, let the mouth part of the crucible, the split side downwards, be placed fronting the mouth of the furnace, and be fixed in such a manner that the furnace fire may not play into it, nor the ashes drop upon your work.

Your furnace may be either round or square; it may be of iron or earth, no matter which; only let there be so much room in the inside as will contain the split crucible or muffle, with a good charcoal fire round about to cover it: you must have a slice, or iron plate, to put your work upon, which, with a pair of tongs, you convey into the furnace, and bring out again.

The metals fittest to enamel upon are gold, silver, and copper; but the best work is performed on gold, for silver makes the white enamel appear of a yellowish hue; and copper is apt to scale, whereby the enamel is subject to break
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in pieces; besides the colours lose a great deal of their charms and lustre to what they appear upon gold. And the gold used for this purpose should be the finest, else the impurities of a bad alloy will have the same effect in the enamel colours as the silver or copper.

Your plate, of whatever metal it be, must be very thin, raised in the nature of a convex; both that and the concave side are laid over with white enamel; that on the convex side, whereon your paint must be laid, a small matter thicker than the other. You must observe that the white enamel which you lay on the convex, be ground with fair water in an agat mortar, and with an agat pestle until it be fit for use: the enamel for the other side must be tempered with water wherein you have before steeped some quince kernels.

As to the enamel colours which you paint with, you must take great care that they be equally tempered, or your work will be spoiled; if one be softer than the other, when your work comes into the furnace and grows hot, the soft colour will intermix with the hard, so as to deface your work intirely: this may serve to caution you to make trial upon a white enamelled plate for that purpose, of all your enamels, before you begin your work: experience will direct you further.

Take particular care that not the least dirt imaginable come to your colours while you are either painting or grinding them; for the least speck thereof, when it is worked up with it, and when the work comes to be put into the reverberatory to be red hot, will leave a hole, and so deface your work.

After you have prepared your plate with a white enamel, and it is ready to paint upon, apply your colours on an ivory pallat, or a piece of glass, in a just order, as in limning, and first delineate your design with a dark red, made of caput mortuum, or crocus martis, ground with oil of spike; put the piece in the muffle, and with a reverberatory fire, as before directed, fix that colour; and then proceed to painting, remembering to dilute the thick and opaque enamel colours with oil of spike; and the transparent ones with fair water: by mixing blue and yellow enamel colour you have a fair green; blue and red a violet; red and white a rose colour; and so of other colours.

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We shall here set down several other receipts for preparing enamel colours to the greatest perfection, which will not only be fit in beautifying and adorning of gold; but also for portraiture or painting on enamel.

To prepare the principal matter for enamel colours.

TAKE lead fifteen pounds, plate-tin ashes sixteen pounds; mix and calcine these as directed in the first part, after you have calcined your lead and tin, search the calx, and put it into an earthen pot filled with water; set it over a fire, and let it boil a little, after which take it off, pour the water into another vessel, which will carry the more subtil calx along with it: repeat this till you can subtilize no more of the calx, and the water comes off clean without any mixture. What gross part remains in the pot, calcine as before, and this repeat till you can draw off no more of the subtil matter. Then pour the water from all your receivers into one that is larger, and evaporate it on a slow fire, lest by a fierce one the calx should founder or settle to the bottom, but continue more fine and subtil than when first calcined.

Of this calx take 12 pounds, frit of white sand beaten and searched 12 pounds, saltpetre purified 12 pounds, salt of tartar purified * and searched two ounces. Put these powders all together into a pot, place it in a glass-house furnace for ten or

* To purify salt of tartar, calcine tartar of red wine in an earthen pot, till it comes black; continue the fire till it changes to a white. Then put it into an earthen pan, glazed; fill the pan with clear water, and boil it over a gentle fire, so that in four hours the water may evaporate the fourth part; then take it off the fire and after the water is settled and cold, pour it off by inclination into a clean glazed pan, and you will have a strong lee. Then pour clean water on the faces, and let them boil as before: this repeat, till the water becomes insipid; then filter the lees; put them in glass bodies upon the ashes in a gentle heat to evaporate, and at the bottom there will remain a very white salt. Dissolve this salt again in fair water, and let it stand two days, for the faces to settle; then filter it, and evaporate it at a gentle fire, as before, and you will have a salt whiter than the former; repeat this three or four times, and your salt will be whiter than snow itself.

twelve

twelve hours to digest and purify. Then take and reduce it to an impalpable powder; keep it in a close dry place for use. Thus is your first or principal matter for enamel colours prepared.

To make enamel of a milk white colour.

TAKE three pounds of the fore-mentioned principal powder, and twenty-four grains of magnesia prepared*, arsenick two pounds, put these together into a melting-pot to melt and purify over a fierce fire; when the matter is thus melted, throw it out of the pot into fair water; and having afterwards dried it, melt it again as before; do this for the third time, changing the water; when you have thus purified it, and found the white colour answer your intent, it is well; but in case it has still a tincture of a greenish hue, add a little more magnesia, and in melting it over again it will become as white as milk, and be fit to enamel with upon gold or other metals: take it off the fire, make it into cakes and preserve it for use.

A turcoise blue enamel.

TAKE of the principal matter or powder three pounds, melt and purify it in a white glazed pot, then cast it into water; when dry put it again into a pot, and being melted over again, add to it at four times this composition: scales thrice calcined † two ounces and a half, prepared zaffer forty-three grains, of prepared magnesia twenty-four grains, stone-blue

* The preparation of the magnesia is thus; put some pieces in an iron ladle into a reverberatory fire; and when it begins to whiten, sprinkle it with good vinegar, after which heat it, and wash it whilst hot; then dry it, and reduce it into a powder.

† To calcine copper scales, such as come from the hammer of braziers or copper-smiths: wash them from their foulness, put them into a crucible, place it in the mouth of a reverberatory furnace for four days; after which let them cool, then pound, grind and searh them. This powder put a second time into the furnace to reverberate four days longer; proceed as before, and after it has stood again the third time for four days, reduce it into powder, and it will be fit for the use intended.

two

two ounces; mix and reduce these to a very fine powder; stir the matter very well with an iron rod, for the powders to incorporate. When your matter is thus tinged, observe well whether your colour answers your intention before you empty the pot: if you perceive the tinging powders are too predominant, add more of the principal powders; and if too faint, add more of the tinging powders. Your own judgment must direct you in the management of this preparation.

A fine blue enamel.

TAKE two pounds of the principal powder, purified, one ounce of prepared zaffer, or of indigo blue; twenty-two grains of copper thrice calcined; mix and reduce these to a fine powder, and put them into a white glazed pot: when the metal is melted, cast it into water; then dry it and put it into the pot again; let it stand upon the fire until it is well incorporated; take it off, make it into cakes, and keep it for use.

A green enamel.

TAKE two pounds of the principal powder, purified, one ounce of copper scales thrice refined, twenty-four grains of scales of iron, copperas two ounces, yellow arsenick one ounce; mix and reduce these to an impalpable powder, and at three several times, or in three several portions, fling it into the principal matter, stirring the metal so as to tinge it equally. When the colour is to your liking, let it stand for a while in the fire, to incorporate thoroughly; then take it off, and you will have a delicate green. *Or,*

TAKE * Feretto of *Spain* two ounces, forty-eight grains of crocus martis prepared with vinegar, yellow arsenick two ounces; pulverize and mix these well, and put them into

* Feretto of *Spain*, is thus prepared: stratify thin plates of copper with vitriol, in a crucible; put it in the mouth of a glass furnace for three days; then take it out, and add to the copper new rows or layers of vitriol, stratifying them as before: then put the crucible again in the same place of the furnace: this repeat six times successively, and you will have an excellent feretto; which beat to powder, and it will tinge glass of an extraordinary beautiful colour.

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a white glazed pot, set it in the furnace to melt, and refine the matter; after which cast it into water; and when dried, throw it again into the pot: when melted, observe whether the colour is to your liking; if so, let it stand for some time longer to refine. If you find the colour too faint, add more of the tinging powder.

A black enamel.

TAKE of the principal powder two pounds, prepared zaffer one ounce, and prepared magnesia one ounce; pulverize and mix these, and proceed as directed in the preceding colours. *Or,*

TAKE of the principal powder three pounds, zaffer one ounce, crocus martis one ounce, feretto of *Spain* one ounce; pound and mix them, and proceed as directed before.

A velvet-black enamel.

OF the principal powder two pounds, red tartar two ounces, prepared magnesia one ounce, pulverize these and put them into a glazed pot, bigger than ordinary, because the metal will rise; for the rest, proceed as directed before.

A purple-colour enamel.

OF the principal powder two pounds, prepared magnesia one ounce, indigo blue half an ounce; proceed as above. *Or,*

PRINCIPAL powder three pounds, prepared magnesia one ounce and an half, of twice calcined scales of copper three ounces, stone blue one ounce; pulverize and proceed as directed.

A violet enamel.

OF the principal powder three pounds, prepared magnesia one ounce, thrice calcined copper scales twenty-four grains, terra verte one ounce; pulverize and mix these all together, and proceed as before directed. *A*

A yellow enamel.

OF the principal powder three pounds, tartar one ounce and a half, prepared magnesia six grains, yellow orpiment two ounces, arsenick one ounce; pulverize them, and proceed as before directed.

An excellent red enamel, of a very splendid ruby colour.

THIS enamel is of a surprising beauty, and its lustre equals that of a red ruby. To prepare this, take equal quantities of magnesia of *Piedmont*, and saltpetre; let them reverberate and calcine in an earthen pot in a furnace for twenty-four hours; take it then off, and wash it well in warm water, to separate the saltpetre; dry it well, and the mass will be of a red colour: to this add an equal quantity of sal-armoniac; grind this on a marble with distilled vinegar, as painters do their colours; dry it and pulverize it; then put it into a strong matrafs, let it sublimate for twelve hours; break off the neck of your matrafs, and mix all the volatile and fixed parts together, adding the same quantity of sal-armoniac as there are flowers, and take care to weigh them before the composition; grind, pulverize and sublimate as before, repeating this until your magnesia remains fusible at the bottom of the matrafs: this preserve to tinge your crystal with; and according to your liking, add either a greater or less quantity of the magnesia, or else of the crystal, until you have brought it to its degree of perfection.

A rose colour enamel.

TAKE five pounds of ground crystal, melt it in a glazed pot, add, at four different times, two ounces and a half of thrice calcined copper; stir the metal every time, then pour into it crocus martis and magnesia prepared as directed; let it stand for six hours to cleanse, and if the colour is too light, add a little more crocus martis, until it be of a fine rose colour.

Observe that all the colours, which are not pure enamel, must be incorporated with the crystalline matter, to the end
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they may vitrify the better, which else they would not easily do. Most workmen make use of rocaille; but that does not answer the purpose so well as ground crystal.

A fine purple.

TAKE half an ounce of fine gold; Neal it and beat it into very thin plates; dissolve this in four ounces of aqua fortis, regulated with sal-armoniac, or old strong salt; put it into a glass cucurbite, which set on warm ashes, or sand, to dissolve; put it to a small matter of saltpetre; when all is dissolved, drop two or three drops of oil of tartar into it, and stop the cucurbite close, to prevent its boiling over: then put in some more drops of oil, and repeat this until it ebullates or boils no more. After this put some lukewarm rain-water to it, and let it stand for some time, and a powder will settle at the bottom of the cucurbite; then pour off the water leisurely into an earthen, or glazed receiver; put more fresh water to the sediment, and repeat this until the water comes off clear, and free from the sharpness of the aqua fortis. When the powder is settled, and all the water poured from it, then put it upon a piece of whited brown paper, to separate it from the rest of the water, and dry it on a warm tile, or in the sun. To one part of this powder, add six parts of the principal powder; grind it with oil of spike, and it will make a good purple.

A good red enamel colour.

TAKE clean Hungarian vitriol, put it into a copper cup, hold it over a fire, and stir it with a silver or copper wire until it is reduced to a white powder; burn this upon a hot tile, on which let it cool of itself; then wash it with rain water, and when settled, pour off that, and put fresh water on, and thus repeat it several times.

But some artists, instead of washing this powder, boil it in fair water, and think this method better than that of washing. With this powder you may tinge the principal matter to what height you would have your colour. Or,

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DISSOLVE vitriol in an earthen pan, and it will fix and shoot at the sides thereof into crystals; which take and burn over a gentle fire between two crucibles well luted: when thus you have burned it to a powder, take and boil it in clean water; and when done, dry it; of this take one part, of the principal powder three parts, and of transparent yellow one and $\frac{1}{8}$ part. *Or,*

PUT vitriol into a crucible, pour a little aqua-fortis upon it, and Neal it gently; then put it in a clean earthen pipkin, pour clean water upon it, and boil it one hour; then pour off that, and put fresh water upon it; wash it, and when settled dry it; Neal it once more, and it is fit for use. Of this powder take two parts, and of the principal powder, or flux, three parts.

A flux for red enamel.

TAKE of red lead four ounces, white scouring sand one ounce; melt it, and pour it into an iron mortar.

Some general observations.

BEFORE we proceed to another subject, we will conclude this article with a few observations and general rules, for the more easy apprehending of what has been said already.

You may observe that gold is the most proper metal to enamel upon; that every colour, except a violet or purple, receives an additional beauty from it to what it does from silver or copper: that it is properest to enrich gold with such beautiful colours, since they raise an agreeable admiration in the beholder when the skilful artist places them in due order.

The ancients only painted in black and white, with something of a carnation or flesh colour; in process of time they indeed made some few improvements, but all their enamel colours were equally alike on gold, silver, or copper, every one transparent; and every colour wrought by itself. But since the modern artists have found out a way of enamelling with opaque colours, and of compounding them in such a manner as to shade or heighten the painting therewith; in the

same manner as is done in miniature, or oil painting, this art has gained the pre-eminence in small portraiture, it having the advantage of a natural and lasting lustre, which is never tarnished nor subject to decay.

The purple coloured enamel does best on silver, from which it receives an agreeable beauty; so does the egmarine, azure and green; all other colours, as well clear as opaque, do not suit therewith; copper suits with all thick enamels, but is unfit for that which is clear.

You must observe to make choice of good, hard, and lasting enamel: the soft is commonly full of lead, which is apt to change the colours and make them look sullied and foul; but if you follow our prescriptions, you will meet with no such inconveniencies.

Remember when you lay your white enamel on either gold, silver, or copper, to dilute it with water of quince-kernels, as has been directed; your clean enamel colours mix only with fair water; and the opaque, when mixed with flux, or the principal powder, dilute with oil of spike.

Be careful not to keep your work too long on the fire, but take it often out, to see when it has the proper glazing, and then it is finished.

Before you use your enamels, give them a little preparation; the most approved by goldsmiths, is, to take the enamel, and after you have ground it to a fine powder, pour on it a little aqua fortis, and afterwards purify and refine it in a small glass cucurbite; then wash it several times in fair water; dry it, and lay it up carefully to keep it from dust: when you use it, grind as much as you have occasion for, with fair water, in an agat mortar; thus do with all your clear and transparent enamels, and by this means you will have all things in readiness to proceed in your work with pleasure.

All opaque colours that will stand the fire, are fit to be used in painting enamel; and the ingenious artist will not be at a great loss, but in searching after them will meet with several colours not yet discovered; as it frequently happens to those who try experiments, and are in pursuit of new discoveries, in this as in any other art.

Of

Of Artificial PEARLS.

IT will not be improper to treat in this place on this subject, as it is a branch relating to jewellers.

The ancients who wrote on the several sorts of precious stones, ranged pearls among the jewels of the first class; they have at all times been in high esteem, and have been eagerly sought for, particularly for adorning the fair sex.

The oriental pearls are the finest, on account of their largeness, colour and beauty; being of a silver white; whereas the occidental or western pearls seldom exceed the colour of milk. The best pearls are brought from the *Persian* gulf, above the isles of *Ormus* and *Bassora*. They are found in *Europe*, both in salt and fresh waters; *Scotland*, *Silesia*, *Bohemia* and *Frisia*, produce very fine ones; though those of the latter country are but very small.

Art, which is always busy to mimic nature, has not been idle to bring counterfeit pearls to the greatest perfection: they are imitated so near, that the naked eye cannot distinguish them from the pearls of the first class, or the real ones, and by this means the wearing of pearls is become universal.

We shall here present the curious with several receipts how to counterfeit pearls in the best manner, and after a method both easy and satisfactory, so as to render his labour pleasant and delightful, and to answer his expectation.

To imitate fine ORIENTAL PEARLS.

TAKE of thrice distilled vinegar two pounds, *Venice* turpentine one pound; mix them together into a mass and put them into a cucurbite, fit a head and receiver to it, and after you have luted the joints, set it, when dry, on a sand furnace, to distil the vinegar from it; do not give it too much heat lest the stuff should swell up.

After this put the vinegar into another glass cucurbite, in which there is a quantity of seed pearl, wrapt in a piece of thin silk, but so as not to touch the vinegar; put a cover or

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head upon the cucurbite; lute it well, and put it in *Bal. Mariæ*, where you may let it remain a fortnight. The heat of the *Balneum* will raise the fumes of the vinegar, and they will soften the pearls in the silk, and bring them to the consistence of a paste; which being done, take them out, and mould them to what bigness, shape and form you please. Your mould must be of fine silver, the inside gilded; you must also refrain from touching the paste with your fingers, but use silver gilded utensils, with which fill your moulds: when you have moulded them, bore them through with a hog's bristle, or gold wire, and let them dry a little; then thread them again on a gold wire, and put them in a glass; close it up, and set them in the sun to dry; after they are thorough dry put them in a glass matrafs into a stream of running water, and leave them there twenty days; by that time they will contract the natural hardness and solidity of pearls. Then take them out of the matrafs, and hang them in mercury water*, where they will moisten, swell, and assume their oriental beauty; after which shift them into a matrafs, hermetically closed up, to prevent any water coming to them, and let it down into a well, to continue there about eight days; then draw the matrafs up, and in opening it you will find pearls exactly resembling oriental ones. This method is very excellent, and well worth the trouble, since by experimenting so fine a secret, you will have the satisfaction of seeing the performance answer the direction above expectation.

Another way to make artificial pearls.

TAKE oriental seed pearls, reduce them into a fine powder on a marble, then dissolve them in mercury-water, or clarified juice of lemons. To make more dispatch, set them in a cucurbite on warm ashes, and you will see presently a cream arise at the top, which take off immediately:

* Mercury-water is thus prepared. Take plate tin of *Cornwall*, calcine it, and let the calx be pure and fine; then with one ounce of the calx, and two ounces of prepared mercury, make an amalgama; wash it with fair water, till the water remains insipid and

diately: take the dissolution off the fire, and when settled, pour off the liquid into another glass, and save it. You will have the pearl paste at the bottom, with which fill your silver gilded moulds, and so put them by for 24 hours: Then bore them through with a bristle; close up the moulds, in barley dough, and put it in an oven to bake, and when about half baked draw it out, take out your pearls, and steep them in the liquor you saved before, putting them in and taking them out several times; then close them up in their moulds, and bake them again with the like dough; but let it remain in the oven till it is almost burnt, before you draw it out: After you have taken your pearls out of their moulds, string them on one or more gold or silver threads, and steep them in mercury-water for about a fortnight; after which time take and dry them by the sun, in a well closed glass, and you will have very fine and bright pearls.

Another way.

Dissolve very fine pulverised oriental pearls in allum-water; when the dissolution is settled, pour off the water and wash the paste that's settled, first in distilled waters, then in bean water, and afterwards set it in *bal. marie*, or horse-dung to digest for a fortnight; this done take out your glass, and the matter being come to the consistence of a paste, mould it as you have been directed before; bore and string the pearls on a silver thread, and hang them in a well closed up glass

and clear; then dry the amalgama thoroughly, put it into a matrafs over a furnace, giving it such a heat as is requisite for sublimation. When the matter is well sublimated, take off the matrafs, and let it cool. Take out that sublimate, add one ounce of *Venice* sublimate to it, and grind it together on a marble; put this into another matrafs, close it well, and set it upside down in a pail of water; and the whole mass will dissolve itself in a little time into mercury-water: this done filter it into a glass receiver, set it on a gentle ash fire to coagulate, and it will turn into a crystalline substance: This beat in a glass mortar with a glass pebble to a fine powder, searce it through a fine sieve, and put it into a matrafs, stop it close up, and place it in *baln. marie*; there let it remain, till it resolves again into water; which is the mercury-water, fit for the above-mentioned use.

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limbeck, to prevent the air coming to them: thus dried, wrap every one up in leaves of silver, then split a barbel, and close them up in the belly thereof; make a dough of barley meal, and bake the fish, as you do bread; then draw him, take out your pearls, and dry them in a closed glass in the sun.

To give them a transparency and splendour, dip them in mercury water, or instead thereof, take the herb *gratuli*, squeezed in water, put therein six ounces of seed pearl, one ounce of saltpetre, one ounce of roach alum, one ounce of litharge of silver; the whole being dissolved, heat first the pearls, and then dip them in this dissolution to cool, repeat this about six times running.

If your pearls should not have their natural hardness, then take two ounces of calamy or *lapis calaminaris* in impalpable powder; add to this two ounces of oil of vitriol, and two ounces of the water of the whites of eggs; put them together into a retort, lute a receiver to it, and you will distill a fair water, with which, and some fine barley flower, make a paste, in which coffin your pearls, and bake them as before; thus they will become exceeding hard.

Another method.

TAKE chalk well purified and cleansed from all grossness and sand; of this make a paste, and form thereof pearls, in a mold for that purpose; pierce them through with a bristle, and let them dry in the sun or in an oven; then string them on a silver thread, colour them lightly over with *armenian* bole, diluted in the white of eggs, and when dry, drench them with a pencil and fair water; lay them over with leaf silver, and put them under a glass in the sun to dry; when dry polish them with a dog's tooth.

To give them the true colour, make a glue of vellum shavings thus: After you have washed them in warm water, boil them in fair water, in a new earthen pot or pipkin, to some thickness, and then strain them through a cloth. When you would use it, warm it first, and dip your string of pearls into it, but let there be an interval between each pearl, so as not to touch one another; this will give your pearls a natural lustre.

To

To form large pearls out of small ones, as directed by Korndorffer.

TAKE of mercurial water 14 ounces; put two ounces of *fulph. folis* into a low matrafs, pour the mercurial water upon it, and let it dissolve and extract. Then take of the whitest small pearls 20 ounces, put them into a proper matrafs, and pour the said water upon it. The pearls will by degrees dissolve, and at last turn to a clear calx, much like dissolved silver calx: pour off the mercurial water; boil the calx well out, and dry it; then put it into a clean crucible by itself; and melt and cast it into what form you please. When cold, polish it in the same manner as you do gems or crystals, and you will have your work of the consistence and beauty of the finest and clearest oriental pearl.

To make of small pearls a fine necklace of large ones.

TAKE small oriental pearls, as many as you will, put them into mercurial water fifteen days and nights together, and they will turn soft, like a paste; then have a pearl mould, made of silver; into this convey the paste by a silver spattle or such like implement; but you must not touch the paste with your fingers, and be very careful to have every thing nice and clean about this work: when it is in the mould, let it dry therein; bore a hole with a silver wire thro' it, and let it stick thereon till you have more; but take care they don't touch one another; then have a glass wherein you may fix as upon a pair of stands, your wires with the pearls: put them well closed up in the sun to harden, and when you find them hard enough, put them into a matrafs; lute the neck thereof very close, and sink it in a running spring of water for 20 days, in which time they will contract their natural colour.

To

To clean pearls, when of a foul colour.

TAKE pigeons dung, moisten it with allum-water, to the consistence of a paste : put this into a glass, big enough to hold four times the quantity ; put into this your yellow-coloured or foul pearls, so that they may be covered all over, and set them in a warm place, or behind an oven ; let them stand for a month ; then take them out, fling them into fresh cold allum-water and dry them carefully, and your pearls will become fine and white : if you repeat the operation once or twice, they will be done to greater perfection.

To blanch and cleanse pearls.

FIRST soak and cleanse them in bran water ; then in milk-warm water, and last of all, steep them in mercury-water : then string and hang them in a glass ; close it well, and set them in the sun to dry.

The bran water is made thus : Boil two large handfuls of wheaten bran in a quart of water, till all the strength of the bran is drawn out, which use thus ; take a new glazed earthen pan, in which put your pearls on a string, and pour the third part of the bran-water upon it ; when they have soaked, and the water is just warm, rub your pearls gently with your hands, to clean them the better, and continue this till the water is cold ; then throw off that, and pour on another third part of the bran water that is boiling ; proceed with this as you did before, and when cold throw it away, and pour on the remainder of the water still, proceed as before ; after this heat fair water, and pour it on your pearls, to refresh them, and to wash away the remains of the bran, by shifting them, and pouring on fresh warm water : this do thrice, without handling your pearls ; then lay them on a sheet of clean white paper ; and dry them in a shade ; then dip them into mercury water, to bring them to perfection.

Other

Other methods used in blanching pearls.

POUND alabaſter to an impalpable powder, rub the pearls therewith very gently; this will not only cleanſe them, but if you let them remain in this powder 24 hours afterwards, they will ſtill be the better for it. White coral has the ſame effect, uſed in the like manner.

White tartar calcined and divested of all its moiſture, is very good for the ſame purpoſe.

Salt diſſolved, filtered, coagulated, well dried and ground, is as effectual as any of the former things, for cleanſing of pearls, by rubbing them therewith; and if afterwards you lay them up in ſome coarſe ground millet, it will contribute to their natural brightneſs.

Of DOUBLET S.

Doublets being much in vogue, and the lapidaries arrived to ſuch a perfection in the making of them, that they often deceive even tolerable judges: I ſhall, for the ſake of ſuch as are unacquainted with the ſecrets thereof, ſet down ſome inſtructions, how they are made; and alſo how they may be known and diſtinguiſhed from real gems.

TAKE two drams of clear maſtick; and of the fineſt cleareſt *Venetian* or *Cyprian* turpentine 16 drams; diſſolve this together in a ſilver or braſs ſpoon: if you find there is too much turpentine, then add a little more maſtick to it, to bring it to a right temper. Then take what colour you pleaſe, as *Florentine* lake, dragon's blood, diſtill'd verdegreaſe, or what colour elſe you deſign, for repreſenting a particular ſtone; grind each by itſelf, in the niceſt manner you poſſibly can, and mix each apart with the mixture of maſtick and turpentine, which you ought to have ready by you; and you will find the *Florentine* lake to imitate the colour of a ruby, the dragon's blood that of a hyacinth, and the verdegreaſe the colour of an emerald. But in caſe you
would

would have your colours, as it were, distilled, then get a little box, made of lime-tree, in the shape of an egg or acorn, as represented in plate II. fig. 2.

This box must be turned at the bottom as thin as possible, so that the light may be seen through it. Then make a quantity of any one of the abovesaid colours, mixed with the mixture of mastick and turpentine, and put it into that little box, hung over a gentle glowing coal fire, or in summer-time in the heat of the sun, where the colour will distil through very fine: scrape and put this into little boxes of ivory, to preserve it from dust, for your use, it is necessary to have to every different colour such a different wooden box.

When the colours are ready, take your crystals (first ground exactly to fit upon one another) and make your colours and stone of an equal warmth; lay your colour with a fine hair pencil on the sides of the crystals that are to be join'd together; then clap them against each other as nimbly as possible: press them with your fingers close together; let them cool, and it is done.

How to know a doublet from a natural stone.

TAKE a stone, in case you are dubious about it, and look upon it edge-ways against the light, and if it is a doublet, you will presently see the clear crystal, or the glass, and so find out the imposture.

The crystal glue of Milan.

IS nothing else but grains of mastick, squeezed out by degrees over a charcoal fire, and like a clear turpentine. The pieces which are to be glued together, are first warm'd over a coal fire, then the mastick is put on the point of a bodkin and warm'd; when both are of an equal warmth, wipe your crystal or stone over with it, clap them upon one another, and press them together; what comes out about the sides, scrape off as soon as it is dry, with a knife. This withstands as well cold as hot water, except a fierce fire

Some

Some remarks on doublets.

ALL falsified jewels are made, either of a saphir, or two crystals, by putting a foyle between them, and cementing them together, as has been mentioned before, with mastick. These mimicked stones may easily be discerned by taking one of them between the two nails of your thumbs, and holding them against the light, directing your eye towards the middle of the stone; if the two outer parts appear white, and the middle of a different colour, you may conclude the stone to be false, and made by art.

A peremptory Instruction concerning the FOYLES or LEAVES,
which are laid under PRECIOUS STONES.

IT is customary to place thin leaves of metal under precious stones, in order to make them look transparent, and to give them an agreeable different colour, either deep or pale: Thus, if you want a stone to be of a pale colour, put a foyle of that colour under it; again, if you would have it deep, lay a dark one under it: besides, as the transparency of gems discovers the bottom of the ring they are set in, artificers have found out means to give the stone an additional beauty, which without these helps it would be deprived of.

These foyles are made, either of copper, gold, or gold and silver together: we shall first mention those made of copper only, and are generally known by the name of *Nurenburg* or *German* foyles.

Procure the thinnest copper plates you can, the thinner they are, the less trouble they will give you in reducing them to a finer substance: beat these plates gently upon a well polished anvil, with a polished hammer, as thin as possible; but before you go about this work, take two iron plates, about six inches long, and as wide, but no thicker than writing-paper; bend them so as to fit one on the other; between these Neal the copper

per you design to hammer for the foyles, to prevent ashes, or other impurities getting to them; put your copper foyles between these bended irons, lay them in the fire, and let them Neal; then, taking them out, shake the ashes from them and hammer them until cool. Then take your foyles to the anvil, and beat them until they become very thin, and whilst you beat one number, put in another between the irons to Neal; this you may repeat eight times, until they are as thin as the work requires. You must have a pipkin with water at hand, in which put tartar and salt, of each an equal quantity, this boil, put the foyles in, and stir them continually, until, by boiling, they become white: then take them from the fire, wash them in clean water, dry them with a clean fine rag, and give them another hammering on the anvil, until they are fit for your purpose.

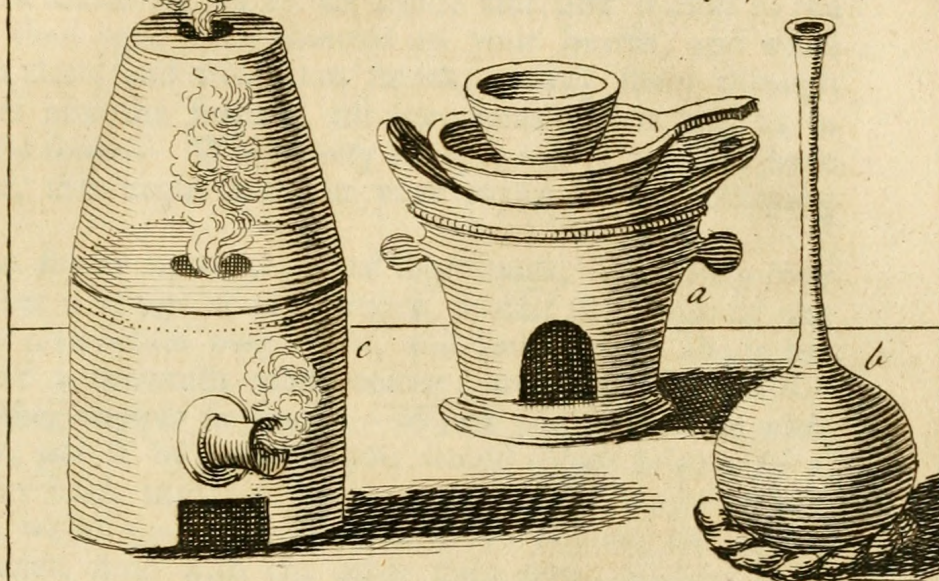
N. B. Care must be taken in the management of this work, not to give the foyles too much heat, to prevent their melting; neither must they be too long boiled, for fear of attracting too much salt.

How to polish and colour the foyles.

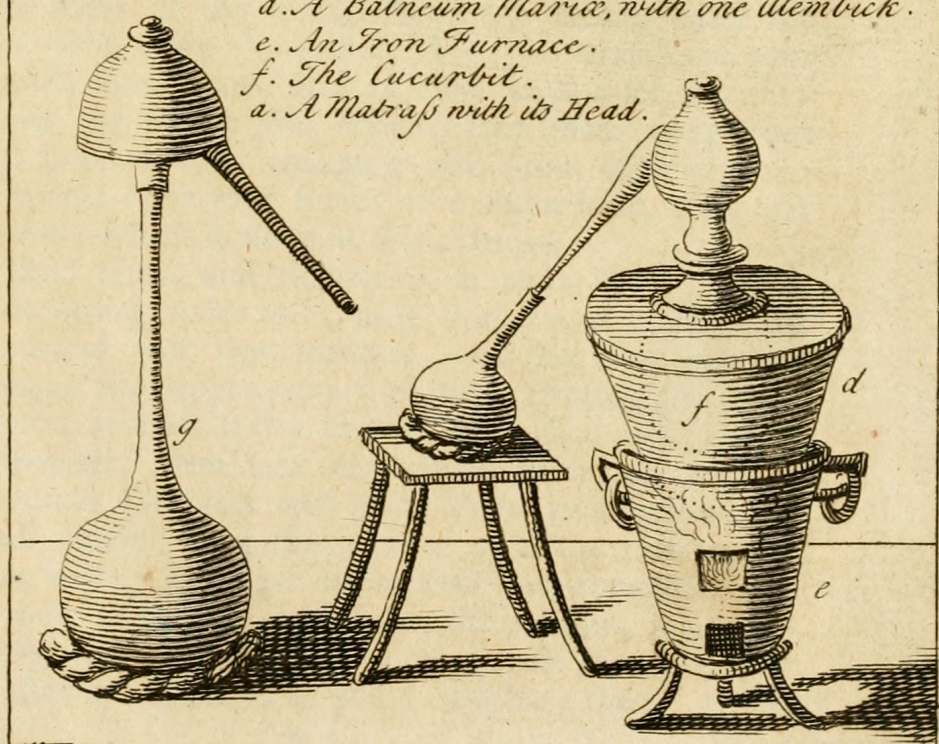
TAKE a plate of the best copper, one foot long, and about five or six inches wide, polished to the greatest perfection: bend this to a long convex; fasten it upon a half roll, and fix it to a bench or table: then take some chalk, washed as clean as possible, and filtered through a fine linen cloth until you think it cannot be finer; and having laid some thereof on the roll, and wetted the copper all over, lay your foyles upon it, and with a polish-stone and the chalk, polish your foyles until they are as bright as a looking-glass; and when so, dry them between a fine rag, and lay them up secure from dust. I shall now shew how these foyles are coloured, but first give a short description of the oven, or furnace, that is requisite for that purpose.

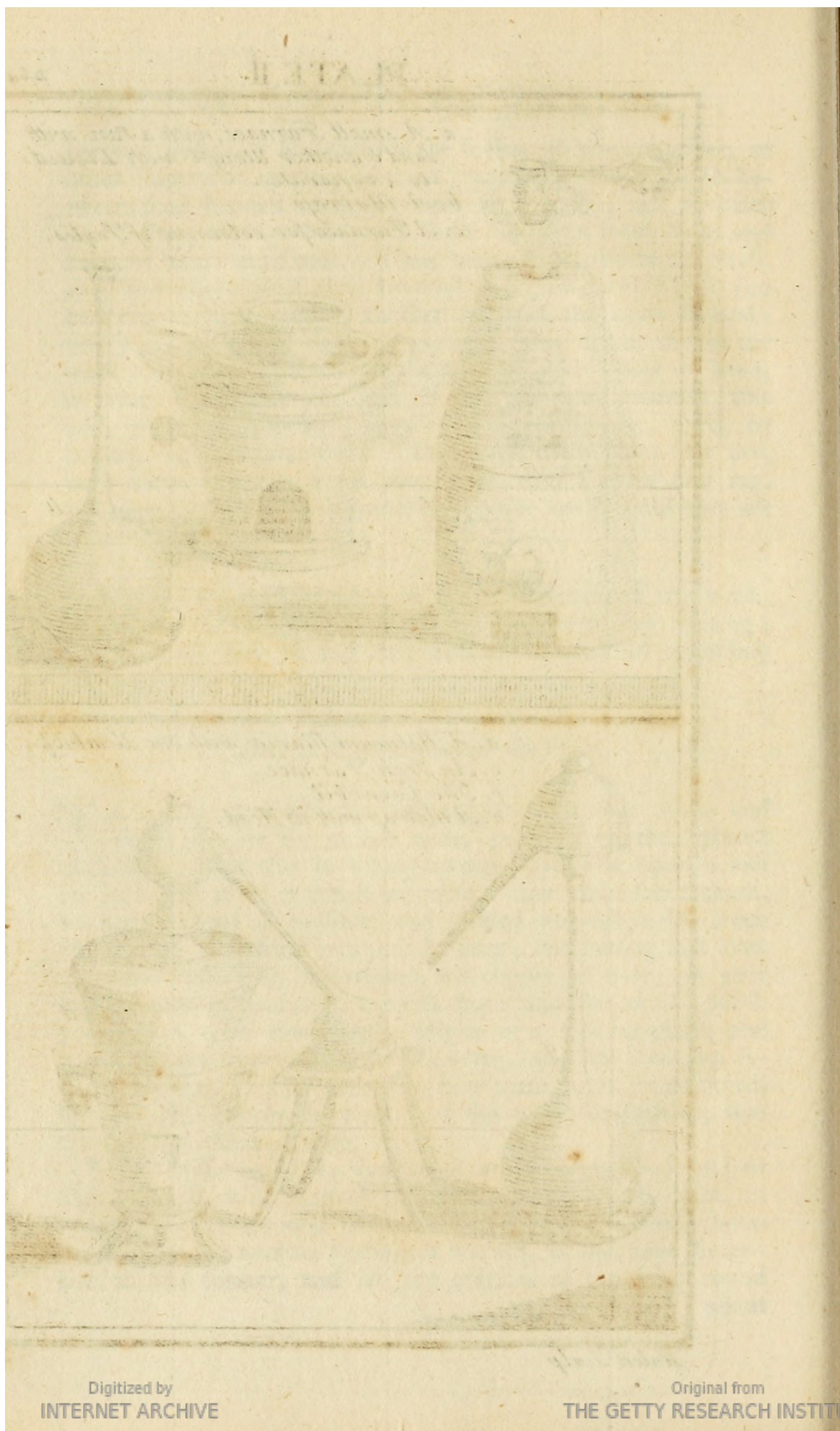
The furnace must be but small and round, about a foot high, and as wide; cover the same with a round plate, in which must be a round hole, about four inches wide; upon this furnace put another without a bottom, of the same dimension as the former, and let the crevices of the sides round about

- a. A small Furnace, with a Pan with Sand & another Utensil with Liquid to evaporate.
 b. A Matrafs.
 c. A Furnace for colouring of Foyles.



- d. A Balneum Mariae, with one Alembick.
 e. An Iron Furnace.
 f. The Cucurbit.
 a. A Matrafs with its Head.





about be well closed and luted: this furnace must also have a hole at top. The lower furnace must have a little door at bottom, about five inches big. Before this fix a sort of a funnel, like a smoak-funnel to an oven, and lute it close to the furnace; then light some charcoal on your hearth, and when they burn clear, and free from smoak, convey them through the funnel into the furnace, till they come up so high as to fill half the funnel. When every thing is ready, and you have a clear fire, then begin to colour your foyles in the following manner.

Lay the foyles upon a pair of iron tongs, hold them over the hole that is at top of the furnace, so that the fumes of the coals may reverberate over them, and move them about till they are of a brownish violet colour; and this is done without any other vapour or smoke. When you have done with this colour, put it by; and if you would colour others, of a saphir or sky blue, then put the foyles upon the tongs as before; and whilst you with one hand are holding the foyles over the holes, fling with the other some down-feathers of a goose, upon the live coals in the funnel, and with a red-hot poker press them down, to drive the smoak of the feathers up through the holes of the oven, which by settling upon the foyles, gives them a fine sky colour: but you must have your eyes very quick upon them, and as soon as you see that they have attracted the colour you design, take them away from the oven, to prevent their changing into some other colour: but if you would have your foyles of a saphir blue, then first silver them over, which is done in this manner.

Take a little silver, and dissolve it in aqua fortis; when dissolved, put spring water to it, fling thin bits of copper into it, and the water will look troubled, and the silver precipitate and hang to the copper; pour off that, sweeten the silver with fair water, and let it dry in the sun; when dry grind it on a porphir-stone: then take one ounce of tartar, and as much of common salt, mix and grind them all together, till they are well mixed; fling this powder upon the thin foyles, and rub them with your finger backwards and forwards, and it will silver them; then lay them upon the polisher, pour water over them, and some of the powder, rub it with your thumb; till they are as white as you would have them: polish

F

them

them with a polisher of blood-stone, and holding them over the goose feather smoak, they will take a fine dark blue.

To colour foyles of a green colour for an emerald.

YOU must first colour your foyles of a sky blue, as directed before; then hold them over the smoak-hole, and below in the funnel lay upon the red-hot iron plate leaves of box, from which ascends a smoak that gives the foyles a green colour; but before they attract that colour, they undergo several changes, as blue, then red, and again yellow; wherefore you must hold them so long, till you have the green colour to your mind.

To colour the foyles of a ruby colour.

PUT the shearings of scarlet cloth upon the coals, and holding the foyles over the smoak-hole, they will attract a fine red colour.

The colour of an amethyst

MAY be had in proceeding with your foyles as for the blue or saphir colour, for before that blue colour comes, it first changes to an amethyst; as soon as you perceive this, take them off, and polish them.

How the foyles are mixed with copper and other metals.

THES E are more difficult to make, but more lasting in their colour. Take one pound and a half of copper, and melt it in a crucible; fling into this two ounces and eleven penny-weights of gold; when in fusion, pour it into a flat ingot, and let it cool: this beat and work, as has been taught, into thin foyles; then boil them in tartar and salt. These sort of foyles will take a fine ruby colour; nor can that colour be well done without this mixture.

Ans-

Another way.

TAKE small-coal dust, put it into a little iron oven, and in the midst thereof a live charcoal; blow it till all the small-coal dust is lighted, and let this glow for two hours: when it is nearly all glown out, add such another quantity to it, and let it glow for an hour. At the top of your oven must be a round or square hole, with a close cover to it, in which hang the foyles to some copper or iron wire: when your small-coal has glow'd for about an hour, take a little iron bowl, and warm it well; put in it a little quantity of fox hair, and then set it upon the small-coal dust; shut the oven door, and open the top: this will draw the smoak through, and give the foyles first the colour of a ruby, then of an amethyst, and at last of a saphir. You may take out such colours as will serve your purpose; and if you want a green, let those foyles hang, and burn sage leaves till the foyles turn to a green colour. Take care to put but a few sage leaves in at a time.

To the ruby and hyacinth colours use pure copper, but for an emerald and saphir you must take one part of gold and two parts of silver, and eight parts copper; melted and work'd together.

Choice Secrets imitating PRECIOUS STONES, or for making
ARTIFICIAL GEMS.

THIS curious art is arrived to that perfection, that it is capable of imitating precious stones in their lustre, colour, and beauty, even to surpass the natural ones, except in hardness, which to obtain, has been, and no doubt still are, the endeavours of several ingenious men.

The art of making artificial gems, consists chiefly in rightly imitating the tints of those that are real: these must be extracted from such things as resist the fire, and do not change their colour, though of a volatile nature: thus verdegrease being put into the fire, is changed to another colour, but when put in fusion with crystal, it retains its natural colour.

F 2

You

You must therefore take such colours as change not, when mixt together: therefore since blue and yellow make a green, you must take such blue as shall not hurt the yellow when you mix them; and also such a yellow as shall not be detrimental to the blue, and so of the other colours. We shall give very plain and certain instruction, to carry the ingenious artist with ease and pleasure through this labour, and first shew him

The way of preparing natural crystal.

TAKE natural crystal the clearest you can get, no matter how big the pieces are, fill a large crucible with them, and cover it with a lid broader than the mouth of the crucible, to prevent the falling of ashes or coals into it: then put it into a small furnace, on burning coals: and when the crystal is thorough hot, cast it into a pretty large vessel of cold water. Then take it out of the water, dry it on an earthen plate, and put it into the same crucible again; cover it, and proceed as before, repeating it 12 times running, and changing each time the water: when the crystal easily breaks and crumbles, and is thoroughly white, it is a sign that it is calcin'd enough: if there appear any black parts in the veins, break off the white, and put these again into the furnace, and proceed therewith as before, till only the white remain behind.

After you have dried this calcined crystal thoroughly, grind it to an impalpable powder, on a marble or porphir stone, and searce it through a silken sieve. Of this powder of crystal, as it is used for all artificial gems of which we shall treat, it will be proper to have a sufficient quantity by you, to have recourse to when at work; and if you would succeed in this art, you must not use ordinary frit of crystal, be it ever so good; for that will not answer, or come up to the lustre or beauty of natural crystal.

To counterfeit an opal.

AT Harlem they make counterfeit opal glafs, which is very lively, and whose several colours are supposed to be produced by different degrees of heat, when the composition is thoroughly

thoroughly melted, some of it taken out on the point of an iron rod, which being cooled either in the air or water, is colourless and pellucid, but being put again into the mouth of the furnace upon the same rod, and turned round for a little time, its particles acquire such various positions, as that the light falling on them being variously modified, represents the several colours observable in the true opal. And it is remarkable that these colours may be destroyed, and restored again by different degrees of heat.

To make a fair emerald.

TAKE of natural crystal four ounces, of redlead four ounces, verdegrease forty-eight grains, crocus martis prepared with vinegar eight grains; let the whole be finely pulverized and sifted: put this together in a crucible, leaving one inch empty; lute it well, and put it into a potter's furnace, where they make their earthen ware, and let it stand there as long as they do their pots. When cold, break the crucible, and you will find a matter of a fine emerald colour, which, after it is cut and set in gold, will surpass in beauty an oriental emerald. If you find that your matter is not refined or purified enough, put it again the second time in the same furnace, and in lifting off the cover you will see the matter shining; you may then break the crucible, but not before; for if you should put the matter into another crucible, the paste would be cloudy and full of blisters. If you cannot come to a potter's furnace, you may build one yourself with a small expence, in which you may put twenty crucibles at once, each with a different colour, and one baking will produce a great variety of artificial gems. Heat your furnace with hard and dry wood, and keep your matter in fusion twenty-four hours, which time it will require to be thoroughly purified; and if you let it stand four or six hours longer, it will not be the worse for it.

A deeper emerald.

TAKE one ounce of natural crystal, six ounces and a half of red lead, seventy-five grains of verdegrease, ten grains of crocus martis, made with vinegar: proceed as directed before. Or,

F 3

TAKE

TAKE prepar'd crystal two ounces, red lead seven ounces, verdegrease 18 grains, crocus martis 10 grains, and proceed as before directed.

To make a paste for imitating an oriental topaz.

THE colour of this stone is like water tinged with saffron or rhubarb: to imitate it, take of prepared natural crystal one ounce, of red lead seven ounces, finely powdered and searced; mix the whole well together, and put it into a crucible, not quite full by an inch, lest the matter should run over, or stick to the cover of the crucible in rising; then proceed as directed above. *Or,*

TAKE prepar'd crystal two ounces, native cinnabar two ounces, *æs ustum* two ounces, all finely pulveriz'd and searced; four times as much calcin'd tin; put it all together into a crucible well covered, and proceed as before.

To make an artificial chrysolite.

THIS stone is of a green colour, and some have the cast of gold; to imitate it, take natural crystal prepar'd two ounces, red lead eight ounces, crocus martis twelve grains; mix the whole finely together, and proceed as before, only leaving it a little longer than ordinary in the furnace.

To counterfeit a beryl.

THIS stone is of a bluish sea-green: to imitate it, take two ounces of natural crystal prepared, five ounces of red lead, 21 grains of * zaffer prepared, the whole finely pulverised; put it in a crucible, and cover and lute it; then proceed as directed as above, and you will have a beautiful colour.

* Preparing of zaffer may be done, by putting some pieces into an iron ladle, heating it red hot, and then sprinkling it with strong vinegar; when cold grind it on a stone, then wash it in clear water.

A

A saphir colour.

A Saphir is generally of a very clear sky colour, and is highly esteemed for its beauty. There are some of a whitish colour, like diamonds, others a full blue, and some are of a violet.

To make this paste, take of prepared rock crystal two ounces, red lead four ounces and a half, smalt 26 grains; pulverise and proceed as directed. This colour will come near to a violet.

Another more beautiful, and nearer the oriental.

TAKE two ounces of natural crystal prepared, six ounces of red lead, two scruples of prepared zaffer, and six grains of prepared manganese; all reduced to a fine powder, mix and proceed as before.

Another deeper coloured saphir.

OF prepared natural crystal take two ounces, red lead five ounces, prepared zaffer 42 grains, prepared manganese eight grains; the whole reduced to an impalpable powder, and mixed together; proceed as you have been directed, and you will have a colour deeper than the former, tending to a violet.

To make a paste for an oriental granat.

A Granat is much like a carbuncle; both, if exposed to the sun, exhibit a colour like burning coals, between red and yellow; and this is the true colour of fire. To imitate this stone, take two ounces of natural crystal prepared, and six ounces of red lead, also 16 grains of prepared manganese, and two grains of prepared zaffer; pulverise and mix the whole; put it together into a crucible, and proceed as directed.

Another deeper granat.

OF natural crystal prepared take two ounces, red lead five ounces and a half, prepared manganese 15 grains; pulverise all, and proceed as before directed.

Another Process for counterfeiting of PRECIOUS STONES.

TAKE of black flint stones what quantity you please, and put them into a pail of hot water, and being wet, put them into a hot furnace, this will prevent their flying into small pieces; or else warm them thoroughly by degrees, before you put them into the furnace. When you see that they are thorough red hot, then quench them in fair water, and they will look of a fine white colour; dry and pulverise them very fine: this you may do in an iron mortar, but, as it may contract some of the iron, it will be proper, after you have taken it out, to pour on it some aqua fortis, which will clear it of the iron, and so disengage it from all filth and impurities: wash it in several clean hot waters.

This powder, thus prepared, is fit to be used for making the finest glass, and for imitating the clearest and most transparent gems, especially those that require the lustre of a diamond or ruby: as for a saphir, emerald, topaz, chrysolite, spirel, amethyst, &c. your labour with aqua fortis may be saved, if your mortar is bright and free from rust. Such as have a mortar of porphir, or such like stone, have no occasion to use an iron one, but will save themselves a good deal of trouble.

In case you cannot have black flint stones you may content yourself with pebble, but flint is far preferable, and makes the glass of a harder substance than that made of pebble.

An approved composition.

OF the above powder take three parts, refined saltpetre two, borax and arsenick one part. *Or,*

OF the flint powder three parts, saltpetre two, and borax four parts. *Or,*

O F

OF the aforesaid powder two parts, of refined chryſtalline, pot aſhes, or ſalt of tartar and borax, of each one part.
Or,

TAKE of the above powder ſeven parts and a half, purified pot-aſhes five parts. *Or,*

POWDER ſix parts and an half; ſaltpetre two and a half; borax one half; aſenic one half; and tartar one part.

How to melt theſe compositions, and how to tinge and finiſh your work.

TAKE any one of the above ſpecified compositions, and weigh what quantity you pleaſe, one or two ounces; then mix it with ſuch a colour as you deſign to have it of, as, for inſtance,

To make a ſaphir.

TAKE to one ounce of the compoſition four grains of zaſfer, mix it well together, and melt it in a crucible; if you ſee the colour to your liking, proceed to finiſh it. You may make a ſaphir either deeper or paler, according to what quantity you take of each ingredient; and 'tis the ſame with reſpect to other colours. A new practitioner in this art may make experiments in ſmall crucibles, in order to acquaint himſelf with the nature thereof.

I have already given receipts of moſt colours for imitating precious ſtones, but nevertheleſs I ſhall here lay down ſome experimental rules, neceſſary to be obſerved.

You muſt know, that the crocus martis may be prepared different ways, and each will have a particular effect in colouring of cryſtals; one is prepared with vinegar, another with ſulphur, a third with aqua fortis, and a fourth by only a reverberatory fire.

To

To prepare crocus martis with vinegar.

TAKE iron, or, which is better, steel filings, moisten and mix them up with good strong vinegar in an earthen dish or pan; after which spread them and let them dry in the sun; when dry, beat them fine in a mortar; moisten this powder with fresh vinegar, and dry and beat it again as before; repeat this eight times running, afterwards dry and sift it through a fine hair sieve, and it will be of the colour of brick-dust; but when mixt with glass, of a fine crimson colour. Put this powder up carefully, to preserve it from dust.

To prepare crocus martis with sulphur or brimstone.

TAKE iron or steel filings one part; sulphur three parts; mix them together, and put them into a crucible; cover and lute it well; then set it into a wind-furnace, and give it a strong fire with charcoal for four hours together, then shake it out, and when cold, pulverise and sift it through a fine sieve: this powder put into a crucible, lute it, and place the same in the eye or hole of the glass furnace; let it stand there for fourteen days or more, and it will turn to a red powder inclining to purple: this is a very useful ingredient for tinging of glass.

To prepare crocus martis with aqua fortis.

MOISTEN some iron or steel filings in a glazed earthen plate or dish with aqua fortis, set it to dry in the sun or air; when dry grind it to a fine powder; moisten it again with fresh aqua fortis, dry it and proceed as before, repeating it several times, till you see it of a high red colour; then grind and sift it through a fine hair sieve, and lay it up safe from dust for use.

To prepare crocus martis by a reverberatory fire.

TAKE clean iron or steel file-dust, put thereof into a large pot or pan about the quantity of an inch high, cover it well, and put it into a reverberatory furnace, or any other place where

where it may be surrounded with a strong heat and flame ; the iron will swell and rise in a fine red powder, so as to fill the pot, and will ever force up the lid ; take off this powder, and you will find a good quantity of iron caked together at the bottom, which put again into the furnace, where it will swell and rise into a powder as before ; this continue until you have a sufficient quantity. This is the most valuable crocus, and of great use in the art of colouring or tinging of glafs for counterfeiting of precious stones.

To make a fine hyacinth.

TAKE of crocus martis, or of that iron powder prepared by reverberation, eight or ten grains to one ounce of the composition.

The opal

IS made of silver dissolved in aqua fortis, precipitated with salt ; add to it some load-stone, and mix it up with the above composition, it gives divers colours, so as to represent a natural opal.

A reddish stone

MAY be made of the fragments, or waste, of calcedon, mixed with borax and melted, with which you may make as many changes as you please.

Such as will save themselves the trouble of preparing the composition for counterfeiting precious stones, may use fine crystal or *Venice* glafs, beat in a clean mortar to a fine powder ; of this take eight ounces, borax two ounces, refined saltpetre one ounce. From this mixture you may melt and colour all manner of stones, with little trouble.

BARTHOLOMEW KORNDORFER's secret to make a diamond of natural crystal.

TAKE the best polished crystal, no matter whether large or small, so it is but clear and transparent ; put it in a crucible, with three times as much of my fixed sulphur of gold, so
that

that the crystal may be covered all over with it; then after you have put a lid over it, and luted the crucible well, let it for three days and nights neal in a strong fire; then take it out and quench it in spring water, in which red hot steel is quenched forty-six times running, and you will have a diamond which resembles a natural one in every respect, and is right and good.

Thus far *Korndorffer*, but as to his sulphur he has left us in the dark.

How to make a diamond out of a saphir, according to PORTA's description.

WE use to make it, (the diamond) the surest way, in this manner: we filled an earthen pipkin, or crucible, with quick-lime, and laid the saphir in the midst thereof, covering it first with a tile, and then with coals all over, blowing them gently until we had a clear fire; for if it is blown too much, it may occasion the breaking of the stone.

When we thought that the saphir had changed its colour, we let the fire go out of itself, and took it out to see whether it was turned white; if so, then we laid it again in the crucible, in order to let it cool with the fire; but if it had not the right colour, then we augmented the heat again as before, and looked often to see whether the force of the fire had taken away all the colour, which was done in about five or six hours; if then the blue colour was not quite gone, we began our operation afresh, until it was white and clear. It is to be observed, that the heat of the fire, in the beginning of your operation, must increase by slow degrees, and also in the same manner decrease; for if the stone comes either too suddenly into the heat, or from the heat into the cold, it is apt to turn dark, or fly to pieces.

In like manner all other precious stones lose their colour, some sooner than others, according as they are either harder or softer. The amethyst is very light, and requires but a slow fire, for if it has too much heat, it becomes dark, or turns into chalk.

This is the art whereby inferior precious stones are changed into diamonds; they are afterwards cut in the middle, and a colour

colour given them; and from hence comes the second sort of false diamonds, or doublets.

To make a fine amethyst.

TAKE calcined flint-stone, and sift it through a cambrick, whereof take $\frac{3}{4}$ of an ounce; of fixed saltpetre $\frac{1}{4}$ of an ounce; of borax $\frac{3}{4}$ of an ounce; of *tinct. ven.* and *mort.* $\frac{1}{4}$ of an ounce; manganese $\frac{1}{4}$ of an ounce; put both these tinctures together, and mix them with the ingredients. : then add fixed * nitre and borax, well mixed, to it; put it in a crucible into a wind furnace; give it at first a gentle heat until it is red hot, and thus keep it for a quarter of an hour; then give it a strong fire for two or three hours; at last pour it into a mould, and let it cool by degrees, to prevent its flying asunder.

To make a ruby, or a fine hyacinth.

TAKE vitriol one ounce, and the same weight of water, mix it well together; in this dissolve filings, or very thin beaten steel; set the glass on warm sand, filtrate the solution before it is cold; then set it in a cellar, and it will shoot into crystals, which pulverise; put it under a muffle, and stir it until you see it of a crimson colour; then take it off the fire, put it in a phial, pour on it good distilled vinegar, and after it has stood four days in a gentle warmth, pour off that vinegar, and pour fresh to it, and let it stand four days more; this repeat until the vinegar is observed to make no extraction; then pour off the vinegar, and there will remain at the bottom of your phial a crimson-coloured powder; sweeten this well with warm water. This is the tincture for the ruby or hyacinth.

* The fixed nitre is thus made: take a piece of green oak, about two fingers thick, lay it upon an iron plate; into the middle of the top of the wood put a little heap of saltpetre; light it; and repeat it so often until it burns through the wood, and the saltpetre runs upon the iron: it turns at first blue, but afterwards greenish: you must keep it warm and dry, to prevent it from melting; in this manner one may make as much as one pleases.

Then

Then take black flints, calcine them well, as has been already directed, in order to bring them to a good white powder, and sift this through a cambrick; take thereof, and of *Venice* borax, of each $\frac{1}{2}$ an ounce; of the aforesaid tincture powder eight or nine grains; mix it well together in a crucible, and give it for half an hour a gentle fire; then augment it by degrees, until you see your mixture in the crucible as clear as crystal, and of a crimson colour; then pour it into a mould of what shape you would have it.

To make a ruby palais.

TAKE prepared powdered flint three ounces, fixed salt-petre one quarter of an ounce; borax three grains; some of the abovementioned tincture-powder; of copper and iron fifty-four grains; of prepared manganese five grains; mix all together, and put it into a new crucible; give it at first a gentle fire until it begins to melt, then give it a strong fire for two hours, and let it cool of itself.

To harden Bohemian diamonds.

TAKE black lead two ounces, gold talc two ounces, powder it fine, and mix it well together; then take off this mixture, put it into a new crucible, about half full, and place the said diamonds upon that powder, so as not to touch one another; then put of the powder as much upon them as will fill the crucible; cover and lute it, and set it in a coppel with ashes, so as to have the ashes a hand's breadth about the crucible; then give it a slow fire, and augment the heat by degrees, in order to preserve the stones from breaking, until the pan or coppel which holds your crucible, begins to be red hot; continue it thus for forty-eight hours, then let it cool, and take the stones out of the crucible, and you will find them look black; polish them with ashes of tin; they will not only have contracted a tolerable hardness, but have also a fine lustre, much resembling natural diamonds.

A

A plain direction concerning the polishing of these counterfeits, and also of natural gems.

IT is to be observed, that all glafs, or artificial ftones, may be cut and polished after one method, namely, by ftrewing fine powdered emery upon a leaden plate with water, and holding the ftone firm, grinding it in what form or fhape one pleafes.

If you fling ground tripoli, mixed with water, upon a pewter plate, and add a little copper afhes amongst it, it will have the fame effect.

Pulverifed antimony ftrewed upon a fmooth plate of lead, with tripoli and vinegar, polifhes not only glafs, crystal, granats, calcedons, agates, and amethifts, but all other natural ftones, except the diamond. The diamond is only cut with the diamond powder itfelf. Any fuch diamonds which can be touched by emery, lead, copper, or other metals, or be cut therewith, are falfe; and this is a good teft for knowing a real diamond.

All other precious and hard ftones may be ground or cut with metal and emery, but the polifhing is different.

The faphir is, next to the diamond, the hardeft; it may be polifhed beft with antimony and vinegar, or lead, or with calcined flint-ftone and water, upon copper.

The ruby is polifhed like the faphir.

The emerald and turquoife is polifhed with potter's clay and water, on pear-tree wood, or with tripoli upon wood, or with emery upon pewter.

The beryl is polifhed with calcined mother-of-pearl, or mufcles, upon a board covered with white leather.

A pallas is polifhed with antimony upon copper.

The cornelian, onyx, agate, calcedon, and jafpis, upon tin; with tripoli, or calcined flint, upon pear-tree wood; or with antimony upon lead.

The amethift, topaz, turquoife, and other foft ftones, are polifhed upon a board of lime-tree wood, upon a plate of tin, and upon a board with leather. Firft polifh it, top and bottom, upon the wood; the fmall diamond cuts are done upon the plate of tin, and receive the laft polifhing upon the board that is covered with leather, with the following powder.

A

A powder for polishing soft stones.

TAKE iron scales, mix them with vinegar and salt, and let them stand thus infused for three or four days, the longer the better; then grind the mixture very fine; dry it, and put it in an earthen pot well luted; give it a good fire, and it will be fit for use.

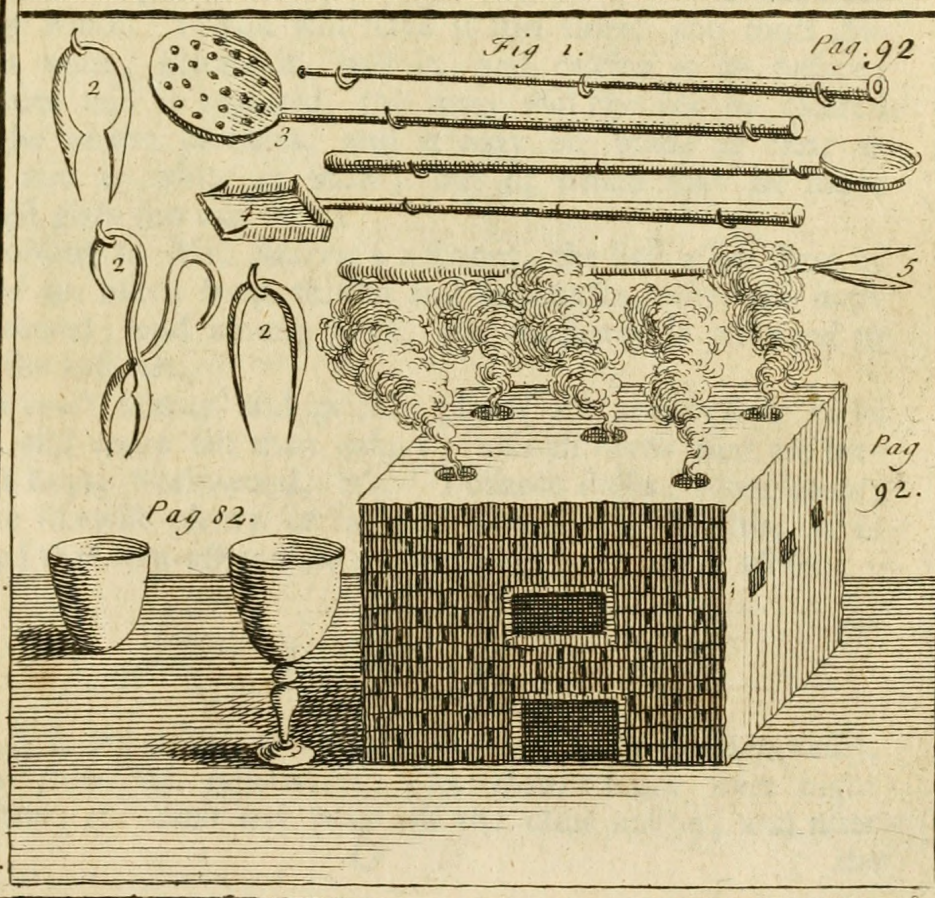
PART III.

The art of making GLASS, exhibiting withal the art of PAINTING, and making impressions upon GLASS, and of laying thereon GOLD or SILVER; together with the method of preparing the colours for POTTERS-WORK, or DELFT-WARE.

To prepare ashes for making glass.

TAKE what quantity, and what sort of wood-ashes you will, except those of oak; have a tub ready with a spigot and foffet towards the bottom, and in this tub put a layer of straw, on which fling your ashes; then pour water upon them, and let the ashes soak thoroughly until the water stands above them: let it thus continue over night; then draw out the foffet and receive the lee in another tub, put under the first for this purpose: if the lee looks heavy and troubled, pour it again on the ashes, and let it settle until it runs clear and is of an amber colour. This clarified lee put by, and pour fresh water on the ashes; let this also stand over night, then draw it off and you will have a weak lee, which, instead of water, pour upon fresh ashes: the remaining ashes are of great use in the manuring of land.

After



Hulett Sculp

After you have made a sufficient quantity of lees, pour them into an iron cauldron, bricked up like a brewing, or washing, copper; but let it not be filled above three parts full. On the top of the brick-work put a little barrel with lee; towards the bottom of which bore a hole, and put a small foffet in, to let the lee run gently into the kettle, in a stream about the roundness of a straw; but this you must manage according to the quantity of lee; for you ought to mind how much the lee in the kettle evaporates, and make the lee in the little barrel run proportionally to supply that diminution. Care must also be taken that the lee do not run over in the first boiling; but if you find it will not keep in the kettle, then put some cold lee to it, slacken the fire, and let all the lee boil gently to a dry salt: when this salt is cold break it out of the kettle, put it into the calcar, and raise your fire by degrees until the salt is red hot, yet so as not to melt: when you think it calcined enough, take out a piece and let it cool; then break it in two, and if it is thorough white it is done enough; but if there remains a blackness in the middle it must be put in the calcar again, until it comes out thoroughly white. If you will have it still finer, you must dissolve it again, filtrate it, boil it, and calcine it as before: the oftner this is repeated, the more will the salt be cleared from the earthy particles, and it may be made as clear as crystal and as white as snow; out of which may be made the finest glass you can desire.

According to Mr. *Marret's* account, the best ashes here in *England* are burnt from thistles and hop-stalks, after the hops are gathered; and among trees, the mulberry is reckoned to afford the best salt.

The most thorny and prickly plants are observed to yield better, and more salt than others; also all herbs that are bitter; as hops, wormwood, &c. Tobacco stalks, when burnt, produce likewise plenty of salt. Notwithstanding this, it is observed that fern-ashes yield more salt than any other ashes.

Another method.

TAKE pot-ashes, dissolve them in a clean earthen vessel, in river or rain-water; let them stand over night and settle; the next day pour off the clear matter, and filter
 G the

the settling through a piece of blanket, in order to get a clear lee : boil this in an iron kettle until it becomes a hard mass ; then beat it into pieces, and put it in a calcar to calcine : dissolve it again in clear water, filtrate and boil it as before ; and the oftener you repeat it, the clearer and finer will be your glass : but if it is for coloured glass, once or twice doing it will be sufficient.

To make the glass frit.

TAKE white silver sand ; wash it, and separate all the impurities from it, and let it dry, or rather calcine it. Of this take 60 pounds, and of prepared ashes 30 pounds ; mix them well together ; then set them in the melting furnace ; the longer it is melting, the clearer will the glass be made thereof. If it stands for two days and two nights it will be fit to work with, or to tinge with what colour you please. Before you work it, add 40 pounds of lead and half a pound of manganese to it. *Or,*

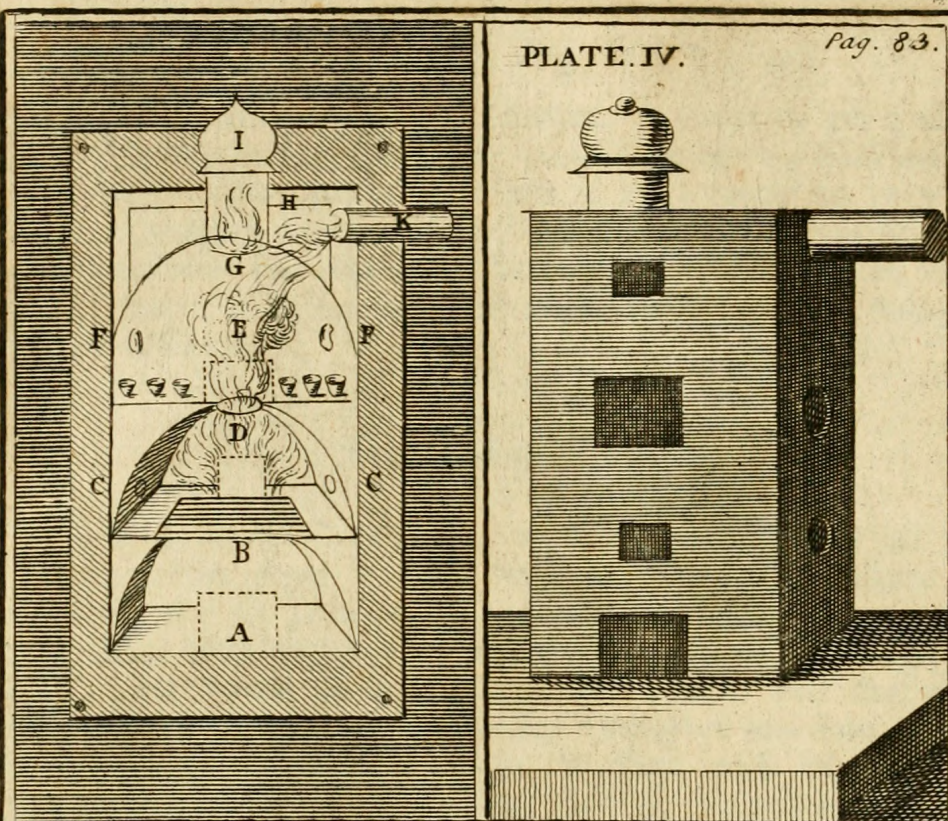
TAKE ashes, prepared as above, 60 pounds ; of prepared silver sand 160 pounds, crystalline arsenick four pounds, white lead two pounds, clear dry saltpetre ten pounds, borax two pounds ; mix all well together, and proceed as has been directed, and you will have a beautiful crystal. *Or,*

TAKE prepared silver sand 20 pounds, clear and dry saltpetre 30 pounds, borax six pounds, crystalline arsenick eight pounds, mix these well together, and put them into fusion for four days ; then add two pounds of manganese and four pounds of borax. *Or,*

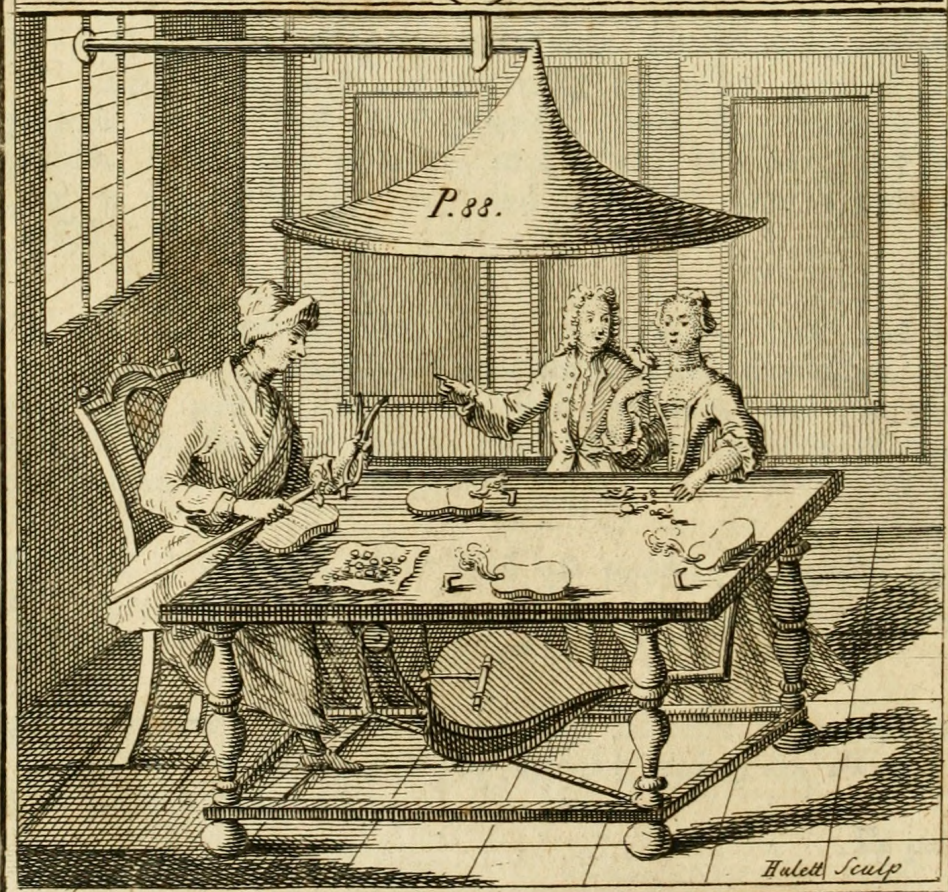
TAKE prepared silver sand 38 pounds, prepared ashes 25 pounds, arsenick one pound, saltpetre two pounds, of antimony and borax four pounds. *Or,*

OF prepared sand take 40 pounds, saltpetre 13 pounds and a half, tartar six pounds, arsenick and borax about one pound and a half. *Or,*

Prepared



A Small Furnace for Experiments.



Hallett Sculp

The Art of Blowing Glass in Miniature.

SCHOOL of ARTS.

F 13

PREPARED silver sand 10 pounds, ashes six pounds, tartar three pounds, saltpetre four pounds, lime six pounds, borax one pound.

How to build a small furnace, useful for experiments in making of glass, and to serve on several other occasions.

YOUR furnace must be built according to the situation and dimension of your room, about a yard square: at the bottom leave a hole, A, which is the receiver of the ashes, and also the drawer of the wind to the fire, which you may make as fierce as you will, by exposing it more or less to the open air. B, is an iron grate, which is about a quarter and a half above the hole A.

C, are holes over the grate, wherein you put the fuel; over the grate is a bricked vault, wherein the flames draw through the hole D, in the upper vault E.

F, are two or more holes, through which you put the crucibles in; you may make one on each side, and make cakes of such clay as the glass makers use, to set them before the holes, and by this means mitigate the flames, which sometimes may strike too fierce upon the upper vault, and give them a little vent.

G, is a hole in the upper vault, which may be covered and uncovered as much as you will, and the flame may either go strait through the funnel H, which at the top is provided with the cover I, and which, on such occasions, must be taken off; or else, in putting on the cover I, you may convey a reverberatory fire through the funnel K, into another little reverberatory furnace, which will be very useful for calcining and preparing several materials, as may happen to be used.

The inside of this furnace must be lined smooth, with such potters clay as the glass-makers use, and two or three inches thick. And having finished it according to this direction, you may place a good many crucibles in at a time, making the holes through which you convey your larger crucibles higher, so that the rim of the crucible may come even with the bottom of the hole, and you may easily convey a ladle, spattle, or any thing else through them. This furnace is the most compendious and useful that can be contrived for a novice in the art of glass-making.

G 2

The

The principal instruments that are used in making of glass, are, 1. A hollow pipe for blowing the glass, with a little wooden handle at top, in order to manage it the better.

Fig. 1.

2. The scissars and shears serve to cut and shape the glass. Fig. 2.

3. Iron ladles, whose handles at the end are covered over with wood; these serve to take the metal out of the large melting pot, and to put it into the little ones for the workmen; for scumming the metal; to take off the alkalic salt which swims on the top, and several other uses. Fig. 3.

4. Great and little shovels, or peels, to take up glass; to draw out the ashes, &c. Fig. 4.

5. Several sizes of forks, to carry the glasses, when made, into the upper oven to cool; for stirring the matter; for conveying the melting-pots in the furnace from one place to another, and for other purposes. Fig. 5.

General observations on the art of glass,

1. **T**HE principal ingredients for making of glass, are stone and salt.

2. The stone is either *Tarso*, a sort of marble brought from *Tuscany*, and reckoned by several artists to be the best for making crystal glass, or black flint stones, which in every respect are as good. And where these are not to be had, clear pebble, or white silver sand, will, when rightly prepared, make also good glass.

3. The next ingredient is salt; which, as has been said, is extracted from ashes, calcined and refined in the nicest and cleanest manner possible.

4. Pulverine, or rochetta, are ashes made of certain herbs which grow in the *Levant*, and are amongst artists allowed to be the fittest to extract the salt for making of glass; of the same kind is soda, which comes from *Egypt* and *Spain*. They prepare these ashes thus: after the herb has been dried in the sun, it is burned on iron grates, the ashes falling through into a pit underneath, made for that purpose, where they grow into a hard mass or stone and are laid up for use; but there is no occasion to fetch the ashes so far, when every country produces

duces sufficient of its own growth ; herbs, as well as trees and plants, answer, in every respect, the same purpose.

Pot-ashes and calcined flint, pebble or sand, will make good glass frit, after you have refined the ashes, by first dissolving them in fair water, and after they are settled, by boiling the clear lees to a salt, then neutralizing the salt in a furnace, dissolving it again, and proceeding as at first, repeating it several times, until it produces a salt as white as snow. Of this you may mix three parts to four of calcined flint, or as you find it requisite ; in all which you will become more perfect by practice than by teaching.

5. Glass is also made of lead, which must be first calcined ; in doing this, you must observe that your kiln be not too hot, but only so as to keep the lead in fusion, or else it will not calcine. When the lead is melted, it yields at the top a yellowish matter, which take off with a ladle for that purpose : after the first calcination repeat it again, and give it a reverberatory fire until it comes to a good yellow powder, and is well calcined. Of the calcined lead take seven pounds, and of the prepared ashes six pounds. Care must be taken that no sediment of lead goes into the crucible but what is reduced to ashes ; else it will make its way through it, bore or rend the bottom thereof, and carry all the metal along with it.

6. Manganese, when prepared as directed, is of great use to whiten your glass ; for, without it, it will have a green hue ; but by mixing manganese with the frit, when melted, by little and little, and then quenching the glass in a pail of cold water, repeating this several times, it will make it of a white and clear colour.

To make glass melt easily.

PUT into the melting pot a little of arsenick that has been fixed with nitre ; this will make the glass mellow, and easy to flux.

To calcine brass, which in glass makes a sky or sea-green.

BRASS is copper melted and mixed with *Lapis Calaminaris*, which not only changes it into a gold colour, but increases its weight ; this mixture gives a sea-green or sky colour

colour to glass, when it is well calcined ; and to do this, observe the following rules.

Take brass plates, cut them into small slips, and put them into a crucible, cover and lute it well, and give it a reverberatory fire in a furnace, yet not a melting one ; for if it melts, all your labour will be lost : let it stand in that heat for four days, by which time it will be well calcined ; then beat it to an impalpable powder and searce it ; grind it fine on a porphirstone, and you will have a black powder, which spread on tiles, and keep it on burning coals, or the round hole of a furnace, for four days ; clear it of the ashes that have fallen upon it, pulverise and searce it, and keep it for use. To try whether it is calcined enough, fling a little thereof into melted glass, which if it swells, the calcination is enough, but if not, then it is either not calcined enough, or else it is burned, and it will not colour the glass near so well as when the calcination is done to perfection.

To calcine brass after another manner, for a transparent red colour or yellow.

CUT your brass into small shreds, and lay it *stratum super stratum* into a crucible, with powder brimstone ; set it on a charcoal fire in a furnace for 24 hours, then powder and searce it : when this is done put it covered into the furnace hole, for 10 hours, to reverberate, and when cold, grind it again very fine, and keep it for use.

General observations for all colours.

1. ALL the melting pots must be glazed with white glass on the inside, else a new earthen pot that is unglazed will cause the colours to look bad and foul ; but the second time of using these pots they loose aheir foulness.

2. Observe that these pots serve for one colour only, and may not be used for another ; for every colour must have its own pot, except they correspond together.

3. Let the powders be well calcined, neither too much nor too little.

4. Your mixtures must be made in due proportion, and the furnace be heated with hard and dry wood.

5. You

5. You must use your colours divided ; one part you must put in the frit before it is melted, and the other after it is melted, and become fine and clear.

To make glass of lead, which is the fittest to be tinctured with most colours.

TAKE of calcined lead 15 pounds ; of rochetta, or pulverised crystal frit 12 pounds ; mix them well, and put them together into a melting pot, then into a furnace, and at the end of ten hours cast them into water ; clear the melting pot of the lead that remains, and return the metal into it, which, after 10 hours heat, will be fit to work withal.

How to work the said glass.

BEFORE you take it upon the iron, raise the glass first in the pot a little, then take it out to let it cool for a small space of time, after which work it on a clean and smooth iron plate.

Blue glass.

TAKE four ounces of calcined and pulverised rock crystal, two ounces of salpetre, one ounce of borax, half a pound of manganese, one pound of indigo-blue.

A chrysolite glass.

TO one pound of frit, take pulverised verdegrease three ounces and a half, red lead one ounce.

A saphir green glass.

TO one pound of the above composition, or crystal frit, take one ounce of good zaffer, and of a curious fine pin-dust two pounds.

To make fine green glass of tin.

TAKE the filings, or shavings, of tin, nine parts, dissolve them in aqua fortis, which is made of two parts of vitriol and three parts of saltpetre; sweeten the calx with clean spring water; then take 18 parts of nine times, or more, calcined antimony: its calcination must be repeated until it has done evaporating. Both these calx melted together, make a fine crysolite or emerald.

This glass will melt upon silver, like enamel, and may be used on several occasions, for embellishing such things as are proper for ornaments.

To make a ruby-coloured glass.

TAKE well settled aqua fortis, made with sal-armoniac and aqua regis, four ounces; fling into it, by little and little, thin bits, or filings, of tin, one ounce, and let it dissolve; then take the finest gold, as much as you will, and dissolve it also in that aqua-regis: take a clean glass with clear spring-water, and pour off the solution of the gold as much as you please into it; the same quantity put also to it of the solution of the tin, and the water will turn in a moment to a fine rose colour, with this water moisten several times your glass frit, and let it dry; then proceed as you do with other glass in fire; at first it must come out white, but afterwards become a fine ruby.

The Art of blowing GLASS in MINIATURE.

This art is performed by the flame of the lamp in the following manner.

FIRST, provide yourself from the glass-house with several pipes of glass, that are hollow in the inside, of several colours and different sizes; then you must have a table, as you see represented in the plate annexed. A is the lamp, which is furnished with rape, or other oil, and a large wick of twisted cotton;

cotton; below the table is a pair of bellows, B. When the artist treads the treadle fastened to the bellows, the wind will be conveyed through the pipes under the table to the small pointed opening by C, directly against which is placed the lighted wick of the lamp, D. The smoak which issues forth from the lamp, is conveyed through a broad funnel made of tin or wood, E.

The wind, which strikes in a sharp point against the flame, occasions such a violent heat that it will dissolve the most stubborn glass, and you may, after you have softened the end of your pipe in the flame, blow through the hollow thereof, and form with small plyers and other useful tools whatever you please: small twisted nooses of wire are very convenient to hold your work in, in order to shape and join different colours to one piece. The whole art depends chiefly upon practice.

The usefulness of such a table answers several other purposes; as, for trying of metal-ore: in this case put some of it in a hollowed charcoal, &c. and by directing the wind through the lamp upon the ore, the heat will melt it immediately, and shew what it contains. In soldering, it is also very convenient; not to mention the conveniency which such a table affords to practitioners in chymistry.

How to lay silver on glass utensils, as plates, dishes, salts, drinking cups, &c.

TAKE silver, what quantity you please, and beat it very thin, or corn it; then put it into a matrafs, and pour twice the weight thereof of spirit of nitre upon it, and you will presently perceive the silver to dissolve: when you observe its ceasing to work, put your matrafs on warm sand or ashes, and it will begin to work afresh; let it thus stand till all your silver is dissolved. After this pour the solution out of that matrafs into another, that has a head to it; with this draw off the spirit of nitre from the solution of silver, and let the matrafs remain on the sand till it is cool; then take it off, and let it stand still for 24 hours, and the silver will shoot into white crystals: from these pour off the solution which remains, and extract from that again the half of the spirit; then put it up as before, to crystallize, and this repeat, till almost all the silver

silver is turned into crystals: which take out of the glass, lay them upon whited brown paper to dry, and preserve them for use. The rest of the silver that remains in the aqua fortis, may be drawn out as has been directed before.

Of this crystal take as much as you will, and put it into a retort; pour upon it two or three times its weight of the strongest spirit of sal armoniac, lute it well, and put it into a gentle warmth for 8 or 10 days to digest, and it will contract a blue colour; pour it off, filter and extract in *Balneo Mariæ* almost all the spirits from it, and there will remain a glass green liquid; with this draw over your glass, and, put it into a glass furnace, or into any gentle heat; your glass will look as if it were silver plate.

But in case there should be an oversight, and the spirit of sal-armoniac be too much drawn off, and the silver turned to a green salt, then pour as much of that spirit upon the silver again to bring it to a green liquid.

A curious drinking glass.

TAKE two smooth drinking glasses, fitted close to each other, so that the brims of both may be even; then paint on the inside of the larger glass with oil colours, what you will, either in imitation of mosaick, or any other invention; and when dry, you may with the point of a needle open fine veins or other embellishments, &c. Then oil it all over with old linseed oil, and before it is quite dry, whilst clammy, lay leaf gold upon it, press it close down to the glass with cotton, and let it dry thoroughly. The mean while take the other lesser glass, and lay a thin clear varnish on the outside thereof; and when almost dry, lay on leaf gold, and the inside of the glass will look all over gilded. When this is dry, put it into the larger glass, and make a paste of chalk and lac varnish, with this lute the rims of the two glasses, so that it may not be perceived, but look as if it were made out of one piece; let it thoroughly dry, and give it another layer of lac varnish, with a fine pencil, and let it dry; then smooth it with pumice stone, and lay on it a thin varnish, and when that is almost dry, gild it with leaf gold, and give it two or three layers of lac varnish, and the gold will remain firm.

When

When instead of painting with oil colour you only anoint the inside of the glass with linseed oil, and then strew it over with spangles, and put the inside glass gilded to join, it will have a singular beauty. This hint will animate the ingenious to try farther experiments of this amusing kind.

How to quicksilver the inside of glass globes, so as to make them look like looking-glasses.

TAKE two ounces of quicksilver, one ounce of bismuth, of lead and tin half an ounce each.

First put the lead and tin into fusion, then put in the bismuth; and when you perceive that in fusion too, let it stand till it is almost cold, and pour the quicksilver into it.

After this, take the glass globe, which must be very clean, and the inside free from dust; make a paper funnel, which put in the hole of the globe, as near to the glass as you can, so that the amalgama, when you pour it in, may not splash and cause the glass to be full of spots; but pour it in gently, and move it about, so that the amalgama may touch every where. If you find the amalgama begin to be curdly, and to be fixed, then hold it over a gentle heat, and it will flow easily again. And if you find the amalgama too thin, add a little more lead, tin, and bismuth to it. The finer and clearer your globe is, the better will be the looking glass.

The Art of Painting upon GLASS.

THIS noble art being the admiration of all who have any tolerable taste of designing or painting, it will not be improper to give the ingenious enquirer after this mystery some few hints, in order, not only to satisfy his curiosity with the nature thereof, but also, if he is inclined, to lead him into the practice of it; which we shall do in the plainest and shortest manner possible.

First then, chuse such panes of glass as are clear, even, and smooth.

2. Strike one side thereof with a clean sponge, or a soft hair pencil, dipt in gum-water, all over.

3. When

3. When it is dry, lay the clean side of the glass on the print or design you intend to copy, and with a small pointed pencil (furnished with black colour, and prepared for that purpose, as shall be directed) delineate the outlines or capital strokes, and where the shades appear soft, work them by dotting and easy strokes one into another.

4. After you have finished your outlines and shades in the best manner you are able, take a larger pencil, and lay on your colours in their respective places; as a carnation in the face, hands, &c. green, blue, red, or any other colour on the drapery, &c.

5. When you have done this, heighten the lights of your work carefully with an unsplit stiff pen, with which take off the colour by way of etching, in such places where the light is to fall strongest, and where it is also of particular use to give the beard or hair a graceful turn.

6. You may lay all sorts of colours on the same side of the glass you draw your design upon, except the yellow; which lay on the other side, in order to prevent its flowing and mixing with other colours, and spoiling your work.

Necessary observations in the baking of glass after it is painted.

FIRST your furnace for baking painted glass must be, and is commonly, built four square, with three divisions, as you see in the print annexed. The lower division, A, is for receiving the ashes, and for a draught for the fire.

2. The middle division is for the fire, which has an iron grate below, and three iron bars cross the top, to set the earthen pan upon, which contains the painted glass.

The third division has the aforementioned bars at the bottom, and a lid at top, in which are five holes for the smoke and flame.

3. The earthen pan is made of good potters clay, according to the shape and dimensions of the furnace, about 5 or 6 inches high, with a flat bottom. It must be fire proof, and no larger than to have at least two inches space all round, free from the sides of the furnace.

The figure here annexed will better explain the description.

4. When you are going to bake your glass, take quick-lime, which previously has been well nealed or made red hot in a
fierce

fierce coal fire: when cold, sift it through a small sieve, as even as you can, all over the bottom of the pan, about half an inch thick; then with a smooth feather wipe it even and level; when this is done, lay as many of your painted glasses as the room will allow. This continue till the pan is full, sifting upon every layer of glass a layer of the mixed powder, very even, about the thickness of a crown piece. Upon the uppermost layer of painted glass, let the layer of powder be as thick as at the bottom. Put the pan, thus filled to the brim, upon the iron bars in the middle of the furnace, and cover the furnace with a cover made of potters earth, lute it very close all round, to prevent any vent but what comes through the holes of the cover. After you have ordered the furnace in this manner, and the luting is dry, make a slow charcoal or dry wood fire at the entrance of the furnace; increase it by degrees, lest by a too quick fire the glass should be subject to crack: continue thus to augment your fuel, till the furnace is full of charcoal, and the flame conveys itself through every hole of the cover: keep thus a very violent fire for three or four hours, and then you may draw out your essays, which are pieces of glass on which you painted some yellow colour, and place them against the pan; and when you see the glass bended, the colour melted, and of a qualified yellow, you may conclude that your work is near done; you may also perceive by the increase of the sparklings of the iron bars, or the light fireaks on the pan, how your work goes on. When you see your colours almost done, increase the fire with some dry wood, and put it so that the flame may reverberate all round the pan: then leave the fire, and let it go out, and the work cool of itself. Take it out, and with a brush clear your glass from the powder that may lie upon it, and your work is done.

The colours in use for painting upon glass, are next to be treated of, and are as follows.

For a carnation colour.

TAKE menning one ounce, red enamel two ounces; grind them fine and clean with good brandy, upon a hard stone: This, if slightly baked, will produce a good carnation.

A black

A black colour.

TAKE scales of iron from the anvil block 14 ounces and a half; mix with it two ounces of white glass, one ounce of antimony, manganese half an ounce, grind them with good vinegar to an impalpable powder.

2. Take scales of iron one part, and rocaille one part, grind them together very fine upon an iron plate, for one or two days; when they begin to be tough, and look yellowish, and clog to the muller, it is a sign that it is fine enough.

3. Take one pound of enamel, three quarters of a pound of copper flakes, and two ounces of antimony, grind them as before directed.

4. Take glass of lead three parts, copper flakes two parts, and one part of antimony, proceed therewith as before.

A brown colour.

TAKE one ounce of white glass or enamel; half an ounce of good manganese; grind them first with vinegar very fine, and then with brandy.

A red colour.

ONE ounce of red chalk, ground and mixed with two ounces of ground white enamel and some copper flakes, will make a good red; you may try with a little whether it will stand the fire, if not, add some more copper flakes to it. *Or,*

TAKE red chalk, that is hard and unfit to write withal, one part; of white enamel one part; and one fourth part of orpiment; grind them well together with vinegar, and when you use them avoid the smoak, which is poisonous. *Or,*

CROCUS martis, of the rust of iron, glass of antimony, and yellow lead glass, such as the potters use, of each an equal quantity: a small matter of silver calcined with sulphur: grind them together very fine, and they will be fit to paint withal, and produce a good red. *Or,*

Take

TAKE one half of iron flakes, one half of copper ashes, one half of bismuth, a little silver filings, 3 or 4 beads of red coral, 6 parts of red frit from a glass house, one half of litharge, one half of gum, and 13 parts of red chalk.

A blue colour for glass paint.

TAKE Burgundy blue, or blue verditer, and lead glass, an equal quantity, grind, them with water to a very fine powder, and when you use them, lay the flowers that are to be of a blue colour, all over therewith; then raise the yellow parts opened, with a pen, and cover them with a yellow glass colour; observe, that blue upon yellow, and yellow upon blue, always makes a green.

Another blue glass colour.

BLUE verditer or smalt, mixed with enamel, will make a good blue paint.

A green glass colour.

GREEN rocaille, or small beads of the same colour two parts, brass file dust one part, menning two parts; grind them together clear and fine, and you will have a good green when it comes out of the pan. Or,

Æ S Ustum 2 ounces; menning 2 ounces; fine white sand 8 ounces: grind them to a very fine powder, and put them into a crucible; then lute the lid, and give it for one hour a good brisk fire in a wind furnace. After this, draw it off to cool; when cold, pound it in a brass mortar, adding the fourth part in weight, to the powder; grind and mix it well together, and put it into a crucible; then cover and lute it well, and give it a good heat for two hours in a furnace.

A fine yellow paint for glass.

IT has been found by experience, that the best yellow for painting upon glass, is prepared of silver; wherefore, if you would have a fine and good yellow, take fine silver, beat it into thin

thin plates, and dissolve and precipitate it in aqua fortis, as has been directed; when it has settled, pour off the aqua fortis, and grind the silver with three times the quantity of well burned clay from an oven, very fine, and with a soft hair pencil lay it on the smooth side of the glass, and you will have a fine yellow. *Or,*

MELT as much silver as you please in a crucible, and when in fusion, fling, by little and little, so much sulphur upon it until it is calcined, then grind it very fine on a stone; mix it with as much antimony as is the weight of the silver; and when these are well ground together, take yellow ochre, Neal it well, and it will turn to a brown red, which quench in urine, and take thereof double the quantity above specified; mix it all together, and after you have ground it very fine, lay it on the smooth side of the glass. *Or,*

NEAL some thin plates of silver, then cut them into small bits, put them with sulphur and antimony into a crucible; when they are dissolved, pour them into clear water, and thus mixed together, grind them very fine.

A pale yellow.

STRATIFY thin plates of brass in an earthen pipkin with powdered sulphur and antimony, and burn it until it yields no more flame; then pour it red hot into cold water; take it out and grind it fine. Of this powder one part; of yellow ochre, after it is nealed and quenched in vinegar, five or six parts; let it dry; then grind it on a stone, and it will be fit for use.

How to deaden the glass, and fit it to paint upon.

TAKE two parts of iron flakes; one part of copper flakes, three parts of white enamel; grind them all together, with clear water, on a marble stone, or upon a brass or iron plate, for two or three days, as fine as possible; with this rub your glass well over, especially that side you draw your design upon, and you will finish your work much neater.

Some

Some general observations on the management of painting and baking of glass.

FIRST when you lay your glass in the pan, let the painted side be placed undermost, and the yellow uppermost.

2. Dilute all your colours with gum-water.
3. Grind the black and red upon a copper plate, other colours you may grind on a piece of glass, or a stone.
4. Glass-colours ready prepared, are glass enamel, which is brought from *Venice* in cakes of several sorts; also the small glass beads, that are brought over from *Germany*, especially from *Franckfort* on the *Main*. Old broken pieces of painted glass are good for that purpose, so is the green glass of potters, and the glass drops that run from the ware in the furnace.
5. The colours which are used by potters, for painting on earthen ware, may also be used for painting on glass.

A particular way to paint upon a drinking glass.

TAKE a small quantity of linseed, bruise it and put it for four or five days in a little canvas bag, in rain-water, and change the water every day; then press out the moisture, and you will have a clammy substance, like glew; with this grind your colours as usual, then paint or mark with a pencil, what you please upon the glass, and give it by degrees a thorough heat; with the same glew you may also gild the glass before you put it into the fire.

A fine gilding for glass.

TAKE gum-armoniack, dissolve it over night in good white-wine vinegar into another vessel, and grind the gum-armoniack and a little gum-arabick well together with clear water; when they are well incorporated and fine, then write or draw upon your glass what you please; and when almost dry, so that it is but a little clammy, lay on your gold, press it down with some cotton, and let it stand over night, rub the loose gold afterwards with a little cotton gently off the
H glass,

glafs, and you will fee the ornaments, figures or writing to that perfection as you designed them; then dry it slowly over a gentle heat, increafing it by degrees fo as to make it red hot; let it cool of itfelf, and the gold will look fine, and ftand wind or water.

To write or draw upon glafs.

TAKE two parts of lead, one part of emery, and a little quantity of white lead, grind them very fine with clear water, then temper them with gum-water, and with a foft hair pencil lay it all over the outside of your glafs, and when dry, you may with a pen draw or write upon it what you please; then increafe the fire from a gentle warmth to make the glafs red hot; let it cool, and you will fee your drawing or writing fair upon the glafs, which will not be defaced either by cold or hot water.

The Art of Glazing and Painting on fine EARTHEN, commonly called DELFT WARE.

POTTERS who paint with colours on earthen ware, may be ranged in the fame clafs with painters upon glafs, fince they ufe almoft the fame materials, and in many refpects, the fame method.

What has already been faid under the foregoing hand, is fufficient, and may ferve novices in designing and painting as an inftruction to paint flowers, landfhips, figures, or whatever elfe, upon earthen ware. We fhall however here fet down fome receipts that chiefly relate to the glazing of earthen ware but firft fhew,

How to prepare the clay for Delft ware.

TAKE one part of calcined flint; one part of chalk, and one part of capital or the cream of clay, mix and work them well to a proper confiftence.

To

To prepare a white glazing.

TAKE of lead two pound; tin one pound; calcine them to ashes, as has been directed before. Of this take two parts; calcined flint or pebble, one part; salt, one part; mix them well together and melt them into a cake.

The Rotterdam fine shining white.

TAKE of clean tin ashes two pound, lead ashes ten pound, fine *Venice* glass two pound, tartar half a pound, and melt them into a cake. *Or,*

LEAD ashes eight pound, tin ashes three pound, fine clear calcined flint or pebble six pound, salt four pound; melt them into a cake. *Or,*

CALCINE eight pound of lead and four pound of tin into ashes, of these take one quart, salt and pebble of each one pound, and melt them into a cake.

Another fine white for Earthen ware.

CALCINE six pound of lead and three pound of tin to ashes, whereof take two parts, salt three parts, pebble or flint three parts, and melt them into a cake.

Another white.

TAKE eight pound of lead and four pound of tin ashes; among which mix six pound of *Venice* glass, and a handful of rock-salt; melt them into a cake,

A Saltzburg white.

TAKE three parts of lead, six parts of tin; or six parts lead and three parts tin, salt three parts, tartar one part, and pebble five parts, &c. *Or,*

TAKE five pound of lead, one pound of tin, three pound of flint, three pound of salt, &c. *Or,*

H 2

TAKE

TAKE six pound of lead, one pound of tin, melt and burn them to ashes; whereof take 12 spoonfuls, 12 of flint, and 12 of fine wood ashes.

To lay a ground upon earthen ware, on which the white glass will better spread.

TAKE calcined tartar one pint, flint and salt of each one pint, mix them together, and use them for a layer or ground over your earthen ware, before you glaze them.

The right Dutch mastirat for white porcelain.

TAKE calcined pebble, flint or sand, 100 pound, of soda 40 pound, wood ashes 30 pound. This mixture is by the Dutch called *mastirat*; of this take 100 pound, tin and lead ashes together 80 pound, common salt 10 pound, and melt them three times in a cake.

The tin and lead ashes are made of 100 pound of lead and 30 pound of tin.

The common ware is thus glazed.

TAKE 40 pound of clear sand, 75 pound of litharge or lead ashes, 26 pound of pot ashes, and ten pound of salt; melt them three times into a cake, quenching it each time in clear cold water. *Or,*

TAKE clean sand 50 pound, lead ashes 70 pound, wood-ashes 30 pound, salt 12 pound, melt them to a cake.

With this mixture they glaze fine and coarse, and set it in an earthen glazing pan, which is round; the ware is set in them upon three cornered bars, that go through the like holes in the pan, and the ware is kept asunder from touching one another.

The opening before, is only left in the figure to see how the ware stand, otherwise the pan must be entirely closed up.

Of

Of several Colours for POTTER'S GLAZE WORK.

A fine yellow.

TAKE red lead three pints, antimony and tin, of each two pound, melt them into a cake, grind it fine, and melt it again. Repeat this several times, and you will have a good yellow. Or,

TAKE 15 parts of lead ore, three parts of litharge of silver, and 15 parts of sand. Or,

TAKE eight parts of litharge, nine parts of calcined flint, one part of antimony, and a little iron filings; calcine and melt them to a cake.

Fine citron yellow.

TAKE six parts of red lead, seven parts of fine red brick-dust, two parts of antimony; melt them to a cake.

A green colour.

TAKE eight parts of litharge, eight parts of Venice glass, four parts of brass dust; melt them for use. Or,

TAKE 10 parts of litharge, 12 parts of flint or pebble, one part of *æs ustum* or copper ashes.

Blue colour.

TAKE lead ashes one pound, clear sand or pebble two pound, salt two pound, white calcined tartar one pound, Venice or other glass 16 pound, zaffer half a pound, mix them well together and melt them; quench them in water, and melt them again; repeat this several times: but if you will have it fine and good, it will be proper to put the mixture in a glass furnace for a day or two. Or,

H 3

TAKE

TAKE litharge four pound, clear sand two pound, zaffer one pound; calcine and melt it together. *Or,*

TAKE 12 pound of lead, one pound of tin, and one pound of zaffer, five pound of sand, and three pound of salt, tartar and glass one pound; calcine and melt it into a cake. *Or,*

TAKE two pound of litharge, a quarter of a pound of sand, one pound of zaffer, and one pound of salt; melt them as directed. *Or,*

ONE part of tartar, one part of lead ashes, one part of zaffer, one part of sand, and two parts of salt; melt it as before.

A brown colour.

TAKE of common glass and manganese or brown stone, of each one part, lead glass 12 parts.

A flesh colour.

TAKE twelve parts of lead ashes, and one of white glass.

Purple brown.

TAKE lead-ashes, 15 parts, clear sand 18 parts, manganese one part, white glass 15 measures, and one measure of zaffer.

Iron grey.

TAKE 15 parts of lead-ashes, 14 parts of white sand, five parts of copper-ashes, one of manganese, one of zaffer, and one of iron filings.

A black.

TAKE lead-ashes 18 measures, iron filings three, copper ashes three, zaffer two measures; this, when melted, will make a brown black; but if you will have it blacker, put some more zaffer to it.

Brown on white.

Manganese two parts, red lead and white glass one part; melt them well together.

A

A fine red.

TAKE antimony two pound, litharge three pound, rust of iron calcined one pound, grind it to a fine powder.

To glaze with Venice glass.

WHEN your ware is well dried, and ready to bake, strike it all over with white-wine lees; then lay on the Venice glass (ground fine and mix with salt of tartar and litharge) and bake it as directed.

A green.

TAKE copper dust two parts; yellow glass two parts; melt them twice. *Or,*

TWO parts of copper filings, one of lead-ashes, and one of white glass; melt them to a cake.

Yellow.

MENNING three parts, brick-dust two parts, lead-ashes two parts, antimony two parts, sand one part, of the above white glass one part, well calcined and melted. *Or,*

RED lead four ounces, antimony two ounces, melt them to a cake.

Good yellow.

TAKE of antimony, red lead and sand, an equal quantity, and melt it to a cake.

A fine blue glass to paint with.

TAKE lead ashes one pound, clear sand two pound, salt two pound, white calcined tartar one pound, flint glass half a pound, zaffer half a pound, melt them together and quench them in water; then melt them again and repeat this several times.

Zaffer finely ground by itself, makes good blue, to paint white-glazed earthen ware.

H 4

A brown.

ONE part of manganese, one of lead, and one of white glafs.

A liver colour.

TAKE 12 parts of litharge, eight of salt, six of pebble or flint, and one of manganese.

A sea green.

TAKE five pound of lead-ashes, one pound of tin-ashes, three pound of flint, three quarters of a pound of salt, half a pound of tartar, and half a pound of copper dust.

To lay gold, silver or copper on earthen ware, so as to resemble either of these metals.

MAKE an utensil of fine potters earth, form and shape it thin, neat, and silver fashion; then bake it, and when baked, glaze it: but before you bake it again, if you will silver, gild or copper it, take a regulus of antimony, melt your metal with it, and beat it to a powder, grind it with water very fine, and glaze it therewith. Then bake it, and when done, the whole utensil will look like silver; for when it comes into the fire, the antimony evaporates and leaves the silver, &c. behind. But if you will silver or gild it only for ornament sake, and keep it from any wet, then you may lay on the gold or silver leaves with brandy, and afterwards polish and finish it in the best manner, after the common method.

PART

P A R T IV.

Several uncommon Experiments for Casting in SILVER, COPPER, BRASS, TIN, STEEL, and other Metals; likewise in WAX, PLAISTER of PARIS, WOOD, HORN, &c. With the Management of the respective Moulds.

To prepare clay in such a manner as to be fit to make all manner of moulds to cast gold, silver and other metals in.

TAKE clay, as much as you will, put it into an earthen pot that's glazed, and cover and lute it very close, then put it into a potter's furnace, and let it stand as long as other earthen ware. After it is burned and cold, grind the clay upon a colour stone very fine, sift it through a fine hair sieve into clear water, and after it is settled, pour off the water, and grind the clay once more upon the stone, as fine as possible; then wash it again in fair water as before, and set it in the sun or in a warm place to dry.

After this burned and washed clay is thorough dry, take thereof three pounds, sal-armoniac two pounds, tartar two pounds, vitriol one pound; mix them together, and put this mixture into one or two pots, pour upon it about seven quarts of clean water, and boil this composition for some time; then take this water, whilst it is warm, and mix your burned clay therewith to such a consistence that you may form it into balls; lay these in a warm place to dry, and when dry, put them into an earthen pot as before, and give them another baking among the earthen ware, and when cold, grind them fine, and that powder will be fit for use.

The clay being thus prepared, take sal-armoniac, put it into a glass with water that holds about two quarts, put so much of the sal-armoniac to the water as will dissolve it over a gentle warmth, and let it stand one or two hours closed up; then take your powder of clay, temper it with this water, to such a consistence

consistence as to form it into balls, and make what moulds you please thereof. When you cast your metal, you must make your mould red hot; and be also very nimble in the pouring out your melted metal.

To make moulds of clay to cast brass or other metals therein.

TAKE good clear clay, such as the pewterers use; take also cloth shaving or fine short plucked cotton, and fine clear sand, and if the sand is not fine enough, grind it on a colour stone; mix this with the clay to such a consistence as is fit to make or form your moulds thereof. Your clay must not be made soft with water, but with strong beer, and when you cast, let your mould be red hot.

If you would have a fine and sharp cast, sift over your clay some fine washed ashes, before you make the impression.

To prepare moulds, which need not to be heated, for casting metal in them.

TAKE fine sand, such as the goldsmiths use, mix it with lamp-black as much as you think proper; then temper it with rape or linseed oil, fit to make your moulds thereof; whatever you cast in them, comes not only out neat and sharp, but you have no occasion to heat your mould, as is required in other cases: this you must observe, that your sand be very dry before you temper it with the oil.

The preparation of Mantua earth, for moulds.

TAKE Mantua-earth one part, and one part of charcoal dust of burnt birch, and one part of salt; then mix with it an equal quantity of tartar; boil up the mixture together in a copper pan, and let it seeth three times: with this water, which keeps always good, moisten and temper your earth, so as to form it into balls between your hands, and when you would make your mould, roll your earth with a roller, till it is smooth and pliable; then you may form it into what fashion you please. In this mould you may cast before it is dried; and when you have cast, take off the earth which is dried through the heat of the metal, grind the same again, and temper it as you did at first to use it again.

A

A particular sort of mould, in which one may cast exceeding fine.

TAKE horse mussels, or for want of them, oyster-shells, let them be calcined in a potters furnace, then pulverize and temper them with urine: of this make your moulds, and you will cast very fine and sharp.

To impress bass relievo or medals, in imitation of ivory.

TAKE of prepared clay one pound, fine plaister of Paris eight ounces, white starch eight ounces; mix these together, and beat up the mixture with the white of six or eight eggs, put to it three ounces of clear gum arabick, stir it well together to a paste, and put so much of the dry mixture to it, till you knead it like dough; then press it into a mould with the palm of your hand, and let it dry in the sun, observing to lay the paste side on a smooth board, and it will be clear and hard, like ivory. You may impress all manner of medals and curiosities, and make them of what colour you please.

To impress medals and other things in bass relievo, on paper.

TAKE the shavings of superfine white paper, and steep them in fair water for six or eight days, then put them into a clean earthen pot with water, and boil them for 2 or 3 hours: this done, take them out of the pot, with as little moisture as possible and stamp them in a stone mortar very small and fine; then put them into a clean linen bag, and hang that in a vessel with clean water, changing the water once or twice a week: when you have occasion to use it, take as much as you want out of the bag, squeezing the water from it and put it on the mould, pressing it down gently with a sponge, which will soak up the water and make the impression more perfect; this being done set the mould to dry in the sun, or in a warm room, and when dry, the impression will come off fair and as sharp as if cast in fine plaister of Paris.

To

To cast vegetables in moulds, peculiarly prepared for silver.

TAKE fine and clear clay or spalter, that is dry, and pound it fine in a mortar; then take a copper or iron pan, put in your clay, and give it a brisk fire, and after you have heated it thoroughly, take it off and let it cool; then take one part of this clay, one part *Alumen Plumosum*, grind them together, and cast the mixture in little tents, which put into a fire to Neal; beat it very fine; and when you would form your plant, take one part of this powder, and one part of *Alumen Plumosum*, grind them together, and add as much of the clay powder as the mixt matter doth contain, and mix and grind them all together. Then take some potters clay, to make a coffin round your plant; spread it in what manner you think proper, and after the coffin is dry, anoint the inside thereof, as also the plant with good brandy; dust the before prepared clay and the plant gently through a fine cambrick, and when you have covered it all over as thick as it will bear, strike the raised coffin a little with your hand or hammer, and the dust will settle closer to the plant and make the silver, cast in, come out the sharper.

After the powder is well settled, and your coffin closed, cover it fine with dead charcoal, and then lay some live ones over them; let the fire gradually descend to the coffin, and heat it by degrees to a strong glue, then let it cool of itself with the fire; take afterward fine clay, fine sand, and some wool shearings; mix this together, beat and knead it well into one another; then temper it with glue, and fill your coffin with it all over the plant, leaving an opening at the stalk for the inlet; then put it again into the fire and make it red hot, and with a pair of bellows, first closed, draw out the ashes from the inlet, and it will be ready for casting.

Then take oil of tartar, which is made of pounded salt of tartar, and scrape a little sal-armoniac into it, to give it the substance of a thin paste, which is a good flux for silver; fling some of this upon your silver when in fusion, and it will cast fine and sharp.

After it is cast, anoint the silver plant with oil of tartar, lay it on live coals, Neal it, and then boil it in tartar, to which you add a little salt, and this will give it a fine bright pearl colour.

A

A curious method to cast all sorts of things in gold, silver, or other metals.

FIRST pound plaister of Paris, or alabaster, to a fine powder, sift it through a cambrick, or very fine hair sieve, and put it into an iron pan, over a clear coal fire; stir it about until it begins to boil and bubble up like water; keep it stirring; recruit your fire, and continue this until you find it so thick as not to be able to draw it along with your stick, then pour it into a bowl and let it cool.

Take also brick-duft finely powdered and sifted.

The miners find sometimes a matter in the iron mines which they call liver ore; take this and wash it from the coarser sand, and when dry, put it into an earthen pot, cover it, set it to Neal thoroughly, and when cold, pound and sift it. When it is right burnt, it will be of a copper colour; put all these different powders into several boxes, and preserve them from dust and soil, for proper use.

To cast vegetables and insects.

FOUR parts of the above plaister of Paris, two parts brick-duft, and two parts liver ore; mix them well together, and sift them through a fine hair sieve, and when you are ready to form your moulds, pour clean water to them, stir them well together to the thickness of a thin paste; but you must be pretty nimble with this work, else it will harden under your hands and be of no use.

The mould you prepare thus.

TAKE the plant you design to cast and spread the leaves and stalks so as not to touch one another; then make a coffin either of lead or clay, put your plant in it so as not to touch the coffin; at the bottom you may lay a piece of paper to keep the stuff from sticking to the board, but let your stuff be neither too thick nor too thin, for if it is of a right consistence it will force itself close to the plants and come out sharp; let the stalks be carefully kept up for the inlet; and when you pour this stuff upon your plants, do it gently, and separate those leaves which might lie close to one another with a needle, pouring all the while, to make the mould the stronger.
After

After this is hardened put it in a dry place, and keep it until you have some more ready to cast, but you must secure it from frost.

If you would cast insects, or any small animal, or reptile, put them in what position you will upon a little board, brown paper, or paste-board, which first must be anointed with oil, in order to make the plaister-stuff come off the easier; about your insect make a little coffin, and if you can raise the insect so as to be freed from the board or paper, it will be the better, which you may do by tying it with two or three hairs, fastening them at the top of the coffin, and by this means it will hang in the middle thereof; when this is ready, pour, as before directed, your plaister gently upon it, and after the mould is a little dry, it will be fit for use.

If you lay your insect, or other creature, upon the paper, you must make a wall about and cast your plaister upon it; let it stand a little, and when dry, take off your wall, and cut the plaister round about the insect; and taking the mould off the paper, there will be an opening at the bottom of the mould where the insect lies; turn this mould, and anoint it about the opening and the part on the insect with oil; then casting some fresh plaister upon that plate, your mould will take afunder, and be very convenient to draw out the ashes of the insect, after it has been burned as is here directed.

Put your mould upon some warm wood-ashes, then cover it with small coal, over the small coal lay charcoal, and then fling some lighted small coal over them to kindle the others so, that the heat may be gently conveyed to the mould; and after it has glowed some time, and you think the insect, or plant, is consumed to ashes, let it cool of itself with the fire about it, to hinder the air coming to it. When your mould is cold, open the hole for the inlet, and either with your breath, or with a little hand spout that is moist, draw out the ashes, and your mould is ready.

You may also burn those moulds in a muffel, if you close the muffel to prevent the air coming in, and lay the coals on and glow it as has been directed. After you have taken out the mould, put the same in warm sand, and having your silver, or other metal, ready melted, pour it in quick; but if you cast silver, fling into the flux a little sal-armoniac and borax, mixed together. After it is cast, let the mould cool a little, then

then quench it in water, and the plaister will fall off of itself, brush the silver clean, and neal and boil it as has been already directed.

To cast vegetables or insects in another manner.

TIE your plant, sprig, or insect with a fine thread to a little stick, dip either of them into brandy, and let it dry a little, then temper your plaister of Paris, prepared as before directed, with water of sal-armoniac, pretty thin, and dip your plant, or insect, in it all over, then put the little stick in the hole against a wall, or any thing else, let it hang free, and in the drying you may display the leaves of the plant, or legs of the insect, as you would have them; and when you have done this, hang it in the coffin, the little stick may rest on each end of the coffin, then pouring your plaister over, you will have an exact mould, then proceed as directed before.

If you would have a small insect to stand upon a leaf, then dip the ends of its legs in turpentine, and put it on the plant before you dip it: if it is a spider or grasshopper, or any other insect which you think will be too strong for the turpentine, kill it first in vinegar, and after that put its legs in the turpentine, and fix it to the leaf of the plant.

To cast figures or medals in brimstone.

MELT (in a glazed pipkin) half a pound of brimstone over a gentle fire, with this mix half a pound of fine vermillion, and when you have cleared the top, take it off the fire, stir it well together, and it will dissolve like oil; then cast it into the mould, after being first anointed with oil, let it cool, and take it out; but in case your figure should change to a yellowish colour, you must only wipe it over with aqua fortis, and it will look like the finest coral.

How to form and cast all manner of small birds, frogs, fish, &c.

TAKE an earthen, iron or tin ring, which is high and wide enough to hold the animal you design to cast, and set a ring upon a clean board or paste-board; then lay the animal

animal upon it, and cast the fine mixture of plaister pretty thick over it, the rest of the vacancy you may fill up with a coarser plaister, even to the brim: when this is done and pretty well dried, turn your ring, and putting a little short stick close to the body of the animal, cast a crust on that side, to cover that part which lay close to the board, and when dry, burn it, and go about the casting as directed: after you have burned or glow'd it thoroughly, you must draw the ashes out of the hole which is made by the little stick, and this you may use for your inlet.

How to cast small shot.

MELT your lead in a ladle, then pour it gently in a continual stream into a pan or pail of water, on the surface whereof swims oil of a finger thick, and you will have good round small shot.

How to cast Images of PLAISTER of PARIS, likewise how to cast Wax, either solid or hollow; also how to form IMAGES in Wax, and cast them afterwards in any Metal, either solid or hollow.

THE preparing the mixture for the moulds has been before shewn, for which reason it is needless to repeat it here again.

If you will make a mould to cast an image, or animal in, take clean potters clay, make thereof a coffin round about the image, which you lay long-ways on a board, and anoint it over with oil; then take fine plaister of Paris, mix it with water, and pour it all over the image, so that it may cover it every way; then give it a stronger coat with a coarser sort, and when the plaister is dry, take off the coffin, and cut that side which is cast something flat, making some notches or marks upon it; then turn it, and make a coffin about it again, and cast that side of the image, after you have anointed it with some oil all over, so that the whole may be entirely inclosed.

After

After the plaister has been a day or two upon the image, it will be quite dry : then with a wooden mallet beat cautiously against the plaister, 'till a piece thereof loosens, which being taken off, the rest will come off easy ; and after you have dismantled the whole, anoint the inside thereof with linseed oil, with a fine hair pencil brush, and let it dry in ; this do twice, and after they have lain two or three days, cut in an inlet, where you think it most convenient, and when you will cast with plaister of Paris, before you do it, anoint the inside of the mould, and after you have put all the pieces in their proper places and tied them together, cast your plaister, and let it stand half a day : take the pieces one after another carefully off, in order to keep the image intire ; but if you will cast wax in that mould, put only the mould for half an hour before in water, and the wax will not stick to it. If you will have the image hollow, then mind that the wax be not too hot ; pour it into the mould, and you will easily see how thick it sticks to it. When you think it is thick enough, then turn your mould about, and pour out the wax that's remaining, and after you have for a little while laid it in water, take off the pieces of moulding, and you will have the image done to perfection. You must observe, that before you break the mould from the image on which you formed it, you must mark it all over with crosses, circles or strokes, by which you may afterwards fix them right and exactly together, to cast again. If you will have the wax figures solid, then let the mould with the images lie for half an hour, or more, to cool in fair water.

To prepare the wax.

TAKE one pound of white rosin, that is not greasy, two pound of wax, melt the wax, strain it through a cloth into a glazed pan, and stir it about till it is cool.

To cast medals and other things in bass relievo.

LAY your medal on a clean piece of paper, or a clean board, inclose it with a wall of clay or wax, then pour the plaister of Paris half an inch thick upon it ; when it is dry, take off the mould, and anoint it with clear fallad oil, two or
I
three

three times, both within and without. If you will cast plaister of Paris, lay the mould first for a quarter of an hour in clear water ; then cast your plaister as thick as you please.

You must observe, that whenever you make a mould of plaister, let it be for bass relievo or figures, you must always anoint it with oil, two or three times, which will not only preserve them from the damage they otherwise would sustain from the water, but make the cast pieces come out clear.

Medals and figures in bass relievo, how to to cast them like jaspis.

TO do this you must have a hand-spout, or a glyster pipe, at the end whereof fix a tin or iron plate, full of round holes, some larger than others. In this spout put a paste, made of fine chalk of several colours; then force them out in small shreds of mixed colours in one piece, cut them with a fine edged knife in thin round slices, and put one into your mould pressing it down gently; then pour the plaister of Paris upon it, and when dry, lay it first over with fish glue, and after that varnish it, and it will be of singular beauty.

The colours you may first dilute with gum-water, before you mix the chalk with them.

Another.

TAKE the abovementioned chalk paste, and after you have mixed therewith a variety of colours, as smalt, white lead, vermillion, red lead, masticot, verdegrease, brown red, &c. and formed each colour separate into little cakes, then (with a rolling pin) spread them like pye-crust, and when you have done as many colours as you think proper, lay one leaf upon another, roll them together from one end to the other, and with a knife cut slices as thin as a wafer; take these and cover your mould with, press it close down with your thumb, and pour the plaister of Paris over it; when dry, do it over with fish-glue, and then varnish it, or give it a polish with a dog's tooth.

To

To cast fish, reptiles, fruit, or any kind of things, in a pewter plate or dish.

TAKE a pewter plate or dish, garnish the same with either fish, reptiles, fruits, plants, &c. Dispose them in proper order, as your fancy directs you. Small animals or leaves of plants fasten to the dish with a little turpentine, and when every thing is in order, wall it round; then pour your plaister of Paris over it; strike upon the table the dish stands on, in order to make the casting fix the closer about the things; after the plaister is dry, make the mould for the back part of the dish; glow it, in order to burn the things to ashes, and having cleared your mould, fix them together for casting, then tie them round with wires, and make them red hot; cast your pewter, and in order not to make the dish too heavy, convey some little openings from the back part of the mould to the body or hollow of the animals, stopping the outside close up again till your casting is over; and when you think the pewter sufficiently fixed, then open these conveyances and pour out the pewter which may remain in the ingot melted.

If you would cast it in silver, then model your leaves, animals, &c. each separate and hollow, that they may be afterwards foldered on.

To cast figures in imitation of ivory.

TAKE izing-glass and strong brandy, make it into a paste, with the powder of very fine grounded egg-shells. You may give it what colour you please: but cast it warm into your mould, having oiled it all over; leave the figure in the mould 'till cold; then set them in the air to dry, and you will have them resemble ivory.

Another.

TAKE a sufficient quantity of egg-shells, put them into an earthen vessel, lute it well, and let them be put in a potter's furnace, and they will burn to white calx, if after the first burning they are not white enough, then burn them a second time; then with parchment-glew mix it into a mass

fit be to cast in moulds, wherein let them dry, if you will have your figures of different colours you must colour your glew, for red with brazil, for green with verdegrease, &c.

Another mixture to cast figures in bass relieve.

TAKE flower of chalk, finely ground, mix it with clear glue well together, pour it into your mould, press it with the palm of your hand, and it will come out very fine: you may do this in what colour you please.

To cast with marble colours in plaister.

TAKE several colours, as vermillion, Dutch pink, yellow ochre, smalt, &c. temper them with water, and mix every one apart with plaister: then take what colours you please, and first sprinkle your mould, which is best of brimstone, with one or more of them, with a little pencil or feather; then pour a colour different from what you sprinkled into the mould, and after it is hardened, give it a gloss with wax or varnish, as pleases you best.

A sand in which one may cast things to the greatest nicety, whether flat or in bass relieve.

TAKE fuller's earth, put it in a reverberatory furnace, so long till it is red hot; then take sal-armoniac about one pound, dissolve it in two quarts of water; with this water moisten the burnt earth, and when cool, put it into the furnace in a red hot pan: after it has glown there, take it out again, when the heat is a little over, sprinkle it with the above water again, till it is quenched, then give it another fire, and repeat this five or six times, the more the better it will receive the metal; then grind it to a very fine powder; put it into the frame, which may be either of brass, iron or wood, but first moisten it a little with the aforefaid water; then make your impression, near the ingot, and having dried it before the fire, while it is hot, cast your metal; the mould or impression will be better the second than the first time using it, but every time you use it, make it first red hot.

To make horn soft.

TAKE one pound of wood-ashes, two pounds of quick-lime, one quart of water; let it boil together to one third; then dip a feather into it, and if in drawing it out the plume comes off, it is boiled enough, if not, let it boil longer; when it is settled, filter it through a cloth: then put in shavings or filings of horn, let them soak therein three days, and anointing your hands first with oil, work the horn shavings into a mass, and print, mould or form it in what shape you please.

To cast horn into moulds.

TAKE horn shavings as many as you will, and lay them in a new earthen pot; take two parts of wood-ashes, and the third part of lime, pour clear lee upon it, so as to cover it all over, boil it well, stir it with an iron ladle, till it has the consistence of a paste: if you will have it of a red colour, then take red lead, or vermilion, as much you think proper, and temper it with the paste; then cast it into a mould, and let it dry: and you may smooth it with a knife, and it will be of one solid piece; you may in this manner bring horn to what colour you will have it.

To cast wood in moulds, as fine as ivory, of a fragrant smell, and in several colours.

TAKE fine saw-dust of lime-tree wood, put it into a clean pan, tie it close up with paper, and let it dry by a gentle heat; then beat it in a stone mortar to a very fine powder, sift it through cambrick, and lay it, if you don't use it presently, in a dry place, to keep it from dust.

Then take one pound of fine parchment glue, the finest gum dragant and gum arabick, of each four ounces; let it boil in clear pump-water, and filter it through a clean rag; then put into it of the said powder of wood, stir it till it becomes of the substance of a thick paste, and set it in a glazed pan in a hot sand, stir it well together, and let the rest of the moisture evaporate till it be fit for casting. Then pour or mix your colours with the paste, and put in oil of cloves, of roses, or the like,

to give it a scent ; you may mix it if you will, with a little beaten amber : for a red colour use brazil ink, and for other colours, such as will be directed under the article for book-binders. Your mould will be better of pewter or brass, than of plaister of Paris ; anoint it over with oil of almonds, and put your paste into it, let it stand three or four days to dry and harden, then take off your mould, and it will be as hard as ivory ; you may cut, turn, carve, and plain it like other wood ; it will be of a sweet scent ; you may, if your mould will allow it, use several colours in one piece, leaving only in some part the natural colour of the wood, in order to convince the beholder what it is. It is a fine and curious experiment.

Of the Mixture for casting MIRROURS, and other Things for OPTICKS.

WE find the method for preparing these mixtures prescribed by several authors, but after different ways ; wherefore I shall set down only a few, which for the generality are best approved of : and first,

TAKE three pounds of the best refined pewter, and one pound of refined copper. First melt the copper, and then add the pewter to it : when both are in fusion, pour it out, and when cold beat it to powder : then take 12 ounces of red tartar, a little calcined tartar three ounces of saltpetre, one ounce and a half of allum, and four ounces of arsenick : mix and stir this together, and after it has done evaporating, pour out the metal into your mould ; let it cool, and when polished you will have a fine mirror.

This is the composition which is commonly called the steel mixture.

Some artists will have the arsenick omitted, because it is apt to turn the mirror into a deadish blue colour, and requires new polishing every time one wants to use it, and they think that copper and pewter are sufficient to answer that purpose.

Another

Another.

TAKE an earthen pan that is not glazed, and has stood the fire; put into it two pounds of tartar, also the same weight of crystalline arsenick, and melt it on a coal fire. When this mixture begins to smok, add to it 50 pounds of old copper, and put it into fusion for six or seven hours, so that it may be well cleansed; then add to it 50 pounds of pewter, and let them melt together; after this, take up some of the mixture with an iron, to see whether it is too hard and brittle; if so, then add a little more tin; and when you have the right temper, fling four ounces of borax over it, and let it stand in the furnace until it is dissolved, then pour it into your mould and let it cool; when it is cold, rub it first with brimstone and then with emery; and after the surface is made smooth and even, polish it with tripoly or tin ashes, and give it the finishing stroke with lamp-black. *Or,*

TAKE copper one part, pewter three parts, and a very little arsenick or tartar; when these are put into fusion let them incorporate.

Some take of copper three parts, of pewter one part, and a little silver, antimony, and white flint.

Others do it with one part of lead, and two parts of silver.

After the metal is formed and cast, it is requisite to have it smooth and well polished: the first is done with emery, then with powder of brimstone or tin ashes, or else with tripoly: the polishing is done with pulverised chimney soot of wood fires, and the ashes of willow, or cedar, which will give it a fine lustre. The emery is ground to a fine dust, and moistened with water. *Or,*

STEEL mixtures are also made out of one pound of pewter, and one third of copper: when these are melted, add two ounces of tartar, and one ounce of orpiment, and when evaporated, pour the mixture out into the mould. The casting of flat mirrour, or looking-glass, is done upon a flat board, which must be made dry and warm, and covered with rosin or pitch; by this means the mirrour is fixed to the board: when

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cold,

cold, rub it with sand and water, then with emery, or flower of brimstone, and at last polish it with tin-ashes.

Another sort of steel mixture for mirrors.

TAKE good new copper, of that sort which is used for copper wire, eight parts; fine *English* pewter one part; bismuth five parts; put it together into a crucible and melt it. Then grease your mould all over with tallow, in order to cast your metal into it; when it is in fusion, dip a hot iron into it; what sticks to it let cool. If the colour is inclining to white it is right; but if to red, you must add some more pewter, until it has its right colour. Observe that whatever you put to the melted metal, must first be made hot. After this manner you may form and cast whatever you please. *Or,*

MELT one pound of copper, fling into it eight ounces of speltar, and when the speltar is in flame, stir it with a stick, or iron rod, well together: then add five or six ounces of fine pewter to it; pour it into your moulds, smooth and polish it as has been directed above, and you will have a fine and bright mirror.

Peter Shot's metallic mixture for mirrors.

TAKE ten parts of copper, melt them, and add four parts of fine pewter; strew upon the mixture a small quantity of pulverised antimony and sal-armoniac; stir it well together until the stinking smoak is evaporated: then pour it out into the moulds, and first smooth it in sand and water, and then proceed as has been directed.

These mixtures for mirrors are made different ways; the copper is the chief ingredient, which must be tempered with a whitish metal, in order to bring the objects that are seen therein to their natural colour; and this is done by pewter and arsenick.

To cast a flat looking-glass, it will be best to have two flat polished stones for a mould; between these two stones put on each end an iron wire, as thick as you would cast your mirror; then tie or screw them close, and fill the openings round about with

with putty, leaving only an opening to pour the metal in. When that is dry and made thorough warm, pour the metal in; and when it is cold, smooth and polish it as directed above. You may fasten the one side to a flat stone with plaister of Paris, and polish the other with a smooth stone; and last of all, give it the finishing stroke with a piece of old hat and fine tin ashes.

If you would cast a concave mirror, or burning-glass, let your mould be exactly turned; but if you cannot get it conveniently done, you may take a round ball, or bowl, and proceed thus:

Make a crust of wax, roll it with a roller to what thickness you would have your metal cast; and to have it of an equal thickness, you may fix a couple of rulers on each side for your ruler to play upon: then cut this crust of wax into a round circle, and form it close to your bowl, and set it in a cool place to harden. In the mean time prepare a fine clay, by washing and pouring it out of one pan into another; take the finest of the settling, and get it burnt in a potter's furnace to a reddish colour. When this is done, grind it with sal-armoniac, sublimate and rain water, upon a marble very fine, and to such a consistence, that it may be laid on with a pencil like painters colour: with this paint one side of the wax mould over, and let it dry in the shade; when dry lay on a stronger coat of haired clay, of about two fingers thick, and let this also dry in the shade. Then lay the concave side uppermost, and do as above. First, with a soft haired pencil, paint the prepared and burnt clay all over; and when dry, lay it over with haired clay, so as to cover the whole mould of wax; the place where you design to cast your metal, you may open after it is dry. Then fix the mould, with the hole downwards, upon a couple of iron bars, or a couple of bricks, making a charcoal fire underneath and round the sides of it, that the wax may melt and run out at the hole: you may catch some of the wax and set it by for other uses. When thus the mould is cleared of the wax, and is still hot, turn it up, and put warm sand round about it to the top to keep it firm; then put an earthen ware funnel into the hole, and pour in the metal; as soon as you begin to pour, fling into the metal a little rag dipped in wax, and whilst it is in flame, pour it out into the mould: after the metal in the mould is cold, polish it carefully, so as to take no more off in one place than
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in another, which, if you do, will prove a detriment to the mirror.

The polishing is best done after the braziers manner, *viz.* with a wheel, to which is fixed a rough sand stone, to take off the coarse crust; then with a fine stone and water, make it smooth, and with a wooden wheel, covered with leather, and laid on with emery, polish it from all the streaks or spots, giving it the finishing stroke with fine tin-ashes and blood-stone, which you apply to the wheel that is covered with leather: continue this so long until it has a perfect gloss. Keep it in as dry a place as possible, to prevent its tarnishing; but if it should tarnish, you must polish it again with a piece of buckskin dipped in fine washed tin ashes. After the same manner you may also polish the concave side of the mirror.

An uncommon art of preparing a mirror mixture on brass.

TAKE strong distilled white-wine vinegar, one pound; fine sal-armoniac four ounces, quicksilver four ounces; let this boil upon a hot sand until the third part of the vinegar is boiled away; this liquor is the principal ingredient for the work; then take a brass plate, polish it very bright with some coal dust, lay it in an iron pan on a gentle coal fire, and when it is pretty hot, dip a rag into this liquor, and rub your plate with it for an hour together; this lays the foundation for what follows; make a paste with one part of quicksilver, and two parts of soap-tin; in this dip your rag, and rub it upon the plate of brass until you have a looking-glass colour.

These plates, thus prepared, lay in the iron pan upon a coal fire until you see they begin to turn to a reddish colour, which they will do in about a minute's time; with this colour the mercury flies away, and the tin colour remains on the plate; then let it cool, and take a little prepared emery upon a piece of leather, and rub the plate over with even strokes, but not too long, for fear of rubbing with the emery the tin from the brass. You may instead of emery polish it also with tripoly.

N. B. If the tin should make the plate too white, you may use lead instead thereof, making a paste with that and mercury, and proceed as above.

By this means you may make what figures you please.

To

To cast iron.

TAKE clean filings of iron, wash them in lee, and then water; mix them with as much powder of sulphur, put the mixture into a crucible, and give it a strong fire until it is in fusion: if you manage it right, it will cast clean and smooth.

To cast steel.

TAKE of the best and finest steel, about one pound; break it into bits, put it in a good strong crucible, and heat it to a bright red colour. Then add 16 or 24 ounces of good common steel, and heat it thoroughly: add then 8 or 10 ounces of * *arsenic glass*, give it a violent fire, and it will melt and flux; with this composition you may cast what you please.

To cast iron as white as silver.

TAKE tartar, saltpetre, arsenic, and clear steel filings, of each an equal quantity; put them together into a crucible, on a charcoal fire; when in fusion, pour the mixture out into an ingot, and you will have out of one pound of steel filings, about two or three ounces of a white bright mass; clear the top of the dross, and preserve the mass for use.

Another method.

TAKE tartar, oil, and a little fixed saltpetre, and mix this into a paste: then put iron or steel filings into a crucible, set it on a charcoal fire, fling the mixture upon it, and it will dissolve and come out like silver; but it is brittle and apt to break. *Or,*

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* *To prepare the arsenic glass*: Take one pound of white arsenic, two pounds of good saltpetre; put it into a new pot that is not glazed, with a cover that has a little round hole in the middle; lute it well all round, then let it dry, and when dry, put the pot in a reverberatory fire for three hours, and there will evaporate out of the hole of the cover

TAKE calcined tartar, and mix it with oil; of this take two ounces, steel filings six ounces; put them together into a luted crucible, and set them in a wide furnace until you think they are melted; then open the crucible, and make a fierce fire until you see the mixture rise; then take it off the fire, clear it from the dross, and cast it into an ingot of what shape you please, and it will be of a white colour.

How to cast pictures with ising-glass, on copper-plates.

TAKE fine white ising-glass, as much as you please, cut it fine, and put it into a glass or cup, pour on it so much brandy as will just cover the ising-glass; close it well, and let it soak all night; then pour some clear water to it, and boil it on a gentle coal fire, until a drop of it, put on a knife, is like a clear crystalline jelly; strain it then through a cloth, and put it into a cool place; where it will turn to a jelly and be ready for use.

When you are about casting a picture, cut so much of the jelly as you think you have an occasion to cover the copper-plate with; dissolve it in a clean pipkin, or such like utensil, over a slow coal fire, and mix any of the colours to be hereafter mentioned amongst it; mean while your copper-plate must be clean, to rub the muschel gold or silver into the graving with a hair pencil; then wipe the plate carefully with clean hands, as the plate printers do; and when this is done, pour your dissolved ising-glass over it, but not too hot, spreading it with a pencil very even every where until your copper-plate is covered: set it then in a moderate warm place to dry; and when you perceive it thorough dry, then, with the help

covered a red poisonous fume; which you must take care of, and keep at some distance from it. The second hour, move the fire nearer the pot, and when the fumes cease, close the hole with some clay: at the third hour put the coals close to the pot, and give it a thorough heat: then let it cool of itself, and at the opening of the pot you will find a white, sometimes a greenish white stone, which put up in a dry warm place free from the air, to prevent its melting: of this you are to take five ounces, and of borax three ounces; grind it well together, and let it melt in a large crucible until it is fluid; pour this into a refining cup, and you will have a fine transparent matter: what is not used, you may preserve from the air to keep it from dissolving.

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of a thin blade of a knife, you may lift it up from the plate; if you find the matter too thin, add more ising-glass to it; but if too thick, add a little more water.

Of the colours fit to be mixed with ising-glass, for casting of pictures.

1. **F**OR red, mix with it some of the liquid in which you have boiled scarlet rags.
2. For blue, take litmus dissolved in fair water.
3. For green, take distilled verdegrease, grind it as fine as possible, and mix it with the above materials.
4. For yellow, steep saffron in fair water.
5. A gold colour is made with the above red and saffron yellow.
6. Gold, silver, or copper, well ground, as is used for painting, are to be mixed with the materials, and poured quickly over the plate. If you first rub printers black in the graving, the gold and silver will look the better.

To cast plaister of paris on copper-plates.

FIRST rub the colour, either red, brown or black, into the graving, and wipe the plate clean; then mix as much plaister as you think you shall have occasion for, with fresh water to the consistence of a thin paste, and having put a border round the plate, of four square pieces of reglets, pour the plaister upon it, and move it so as that it may run even all over the plate: let it stand for an hour, or longer, according to the dimensions of the plate, and when you find it dry, and turned hard, take off the reglets, and then the plaister, and you will have a fine impression of the copper graving. You must observe, not to mix more at a time than you have occasion for, or else it will grow hard before you can use it.

A mixture, which may be used for making impressions of any kind, and which will grow as hard as stone.

TAKE clean and fine sifted ashes, and fine plaister of Paris, of each an equal quantity, and temper the mixture with gum-water, or with size of parchment; knead it well together, and press it down into your mould; but do not prepare

prepare more than what you use presently, else it will harden under your hands. You may give it what colour you please; in mixing it for black, take lamp-black; for red, vermillion; for white, flake-white; for green, verdegrease; for yellow, Dutch pink, &c.

You may, instead of gum or size, use the whites of eggs, which is more binding.

To impress figures in imitation of porcelain.

CALCINED and fine pulverized egg-shells, worked with gum-arabick and the white of eggs into a dough, then pressed into a mould, and dried in the sun, will come out sharp, and look fine.

P A R T V.

A Collection of very valuable Secretss for the Use of SMITHS, CUTLERS, PEWTERERS, BRAZIERS, BOOK-BINDERS, JOINERS, TURNERS, JAPANNERS, &c.

Choice Experiments on IRON and STEEL.

To make steel of iron.

TAKE small iron bars of the finest sort, powdered willow or beech-coals, the shaving of horn, and the foot of a baker's chimney; stratify these in an earthen pan, made for that purpose, with a cover to it. First make a layer of the mixture, about an inch thick; then a layer of iron bars, then again the mixture, and so proceed, till the pan is full; note, the top must be of the mixture: then put the cover upon it, lute it, and put it in a wind-furnace for 24 hours, and give it a reverberatory fire.

To

To harden sword-blades.

SWORD-blades are to be made tough, so as that they may not snap or break in pushing against any thing capable of resistance; they must also be of a keen edge; for which purpose they must all along the middle be hardened with oil and butter, to make them tough, and the edges with such things as shall be prescribed hereafter, for hardening edged instruments. This work requires not a little care in the practice thereof.

How to imitate the Damascan blades.

THIS may be done to such perfection that one cannot distinguish them from the real Damascan blades. First polish your blade in the best manner, and finish the same by rubbing it with flower of chalk; then take chalk mixed with water, and rub it with your fingers well together on your hand; with this touch the polished blade, and make spots at pleasure, and set them to dry before the sun, or a fire; then take water in which tartar has been dissolved, and wipe your blade all over therewith; and those places that are left clear from chalk will change to a black colour; a little after wash all off with clear water, and the places where the chalk has been, will be bright; your watering will be the more perfect as you imitate it in laying on your chalk.

How the Damascan blades are hardened.

THE Turks take fresh goat's blood, and after they have made their blades red hot, they quench them therein; this they repeat nine times running, which makes their blades so hard as to cut iron.

To perfume a sword blade, so as to retain always an odoriferous scent.

TAKE eight grains of ambergrease, six grains of the best bisem, four grains of right cibeth: grind them together with a little sugar-candy, in a glass or agat mortar; after this add to the mixture four scruples of the best benjamin oil, and mix

mix it well together; then hold the sword blade over a gentle, clear coal fire, and when the blade is well heated, dip a little sponge in the forementioned mixture, and wipe your blade all over; tho' you do this only once, yet the odoriferous scent will remain, although, the blade was to be polished again.

To harden steel and iron, which will resist and cut common iron.

TAKE shoe-leather, and burn it to a powder, the older the leather is, the better it is for use; salt, which is dissolved and glass-gall powdered, of each an equal quantity; then take what you desire to harden and wet it therewith, or lay it in urine, and taking it out, strew it over with this powder, or else stratify it therewith in an earthen pan; give it for five hours a slow fire to cement, and make it afterwards red hot for an hour together.

To temper steel so as to cut iron like lead.

TAKE the steel and purge it well, then distil from earth-worms, in an alembick, a water, which mix with an equal quantity of the juice of radishes; in this liquid quench your steel blades of knives, daggers, swords, &c. and they will be of an excellent temper

Several other temperings of steel and iron..

1. **I**RON quenched in distilled vinegar, or in distilled urine, becomes of a good temper.
2. Vinegar, in which sal-armoniac has been dissolved, gives it a good temper.
3. So doth the water in which urine, salt, and salt-petre have been dissolved.
4. Caput mortuum of aqua fortis, boiled for an hour in water, and filtered through a clean cloth, makes a tough hardness.

5. Mix

5. Mix together an equal quantity of saltpetre and sal-armoniac, and put the mixture into a phial with a long neck, then set it in a damp place, or in horse dung, where it will turn to an oily water; this liquor will make iron works of an incomparable temper and hardness, if quenched therein red hot.

6. A lee made of quick-lime and salt of soda, or of potashes, filtered through a linen cloth, gives a very good hardness to iron, if quenched therein.

7. The dung of an animal which feeds only on grass, tempered with water and calcined soap, and mixed to a thin paste, gives such a good temper to iron, as to make it cut untempered iron.

8. Or take *Spanish* radishes, grate them on a grater, and express their juice; this gives a good temper to iron or steel quenched therein.

9. Take the juice of nettles, fresh urine of a boy, ox-gall, salt and strong vinegar, equal quantities of each; this mixture gives an incomparable temper.

10. Red hot iron or steel, wiped over with goose grease, and then quenched in four beer, takes also a good temper.

A particular secret to harden armour.

MAKE the following mixture, taking of each an equal quantity; as common salt, orpiment, burned goat's horn, and sal-armoniac; powder and mix them together; then anoint the armour with black soap all over, strew this powder upon them, and wind a wet rag about them, and lay them in a fierce charcoal fire, till they are red hot; then quench them in urine. If you repeat it, it will be the better.

To temper steel or iron, so as to make excellent knives thereof.

TAKE clean steel, quench it in five or six times distilled rain, or warm water and the juice of *Spanish* radishes; the knives made of such steel will cut iron.

K

Take

Take black or *Spanish* radishes, grate them on a grater, put salt and oil upon them, and let them stand two days. Then press the liquor out, and quench the steel or iron several times, and it will be very hard.

To bring gravers and other tools to their proper temper.

TAKE a little fire pan with live coals, and put a couple of old files, or any other small bars of iron over them; then lay your gravers upon them over a gentle clear charcoal fire, and when you see them change to a yellowish colour, it is a sign that they are softer; after this colour they change to a redish, which shews them still softer; and if you let them turn to a blue, then they are quite soft and unfit for use: after this manner you may soften any steel that is too hard.

General rules to be observed in tempering of iron or steel.

WE know by experience, that the tempering of iron is performed and executed several ways; for every mechanical branch requires a particular method of hardening; the tools that are used for wood, require a different temper or hardness from those used in cutting of stone or iron, and therefore thus are prepared, according to the several methods treated of before: an artist ought therefore to acquaint himself with the nature and quality of the different ingredients and liquors that are here prescribed, and improve upon such as seem most promising. He is to observe the degrees of heat, which he is to give, and the length of time he is to keep the metal in the liquor for quenching; for in case the iron be made so excessively hot, that it is not capable of receiving a greater degree of heat, it cannot well be quenched, and it will become cankered; but if it appears of a saffron or redish colour, it is called gold, and is fit to be quenched, for hardening: however in this as well as most other things, practice is the best instructor.

A

A curious method of hammering iron without fire, and making it red hot.

TAKE a round iron, about an inch thick ; at one end thereof fix a round iron knob ; then begin gently to hammer it under the knob ; turning it quickly round, and by following your strokes harder and harder, the iron will heat of itself, and begin to be red hot ; the reason is because the knob remains untouched, and the heat on each of the motions cannot dissipate.

To soften iron or steel that is brittle.

1. **A** Noint it with tallow all over, Neal it in a gentle charcoal fire, and let it cool of itself.
2. To Neal it thus with human excrement, softens it ; but you must keep it in the fire for two hours.
3. Or, take a little clay, lime, and cow's dung ; cover your iron therewith, and Neal it in a charcoal fire : then let it cool of itself.
4. Or, make iron or steel red hot, and strew upon it good hellebore, and it will become so soft that you may bend it which way you please : this is very useful for those who cut in iron or steel.
5. Take lead, put it into a crucible, or iron ladle, and melt and pour it into oil ; this repeat seven times running. If you afterwards quench iron or steel in this oil, it will be very soft ; and after you have shaped or worked it in what manner you designed it, you may harden it again by quenching it in the juice of onions.
6. Take lime, brick-dust, and *Venice* soap ; with this anoint your steel and Neal it ; then let it cool of itself.
7. Take the root of blue lillies, cut it fine, infuse it in wine, and quench the steel in it.

K 2

Wind

8. Wind about the steel some thin slices of bacon, and over that put clay, let it neal for an hour, and the steel will be very soft.

9. Take quick-lime and pulverised soap, of one as much as the other; mix it together, and temper it with ox's blood; with this anoint the steel; then lay a covering of clay over it, and let it neal and cool of itself.

10. Take the juice or water of common beans, quench your iron or steel in it, and it will be as soft as lead.

A particular powder and oil, to take off the rust and spots of iron, and to preserve it from rust for a long time; very useful in armories.

TAKE two pounds of crucible powder, of such as is commonly used for refining of silver, and sift it through a fine hair sieve: then take four pounds of emery, and one pound of silver ore; pound them all very fine, and sift them; put at last fine beaten scales of iron to them, and the powder is fit for use.

To prepare the oil for it.

TAKE three pound of *Lucca* oil, and put it into a copper bason or pot; then take three pound of lead, melted, and pour it into the oil, take it out, and melt it again, and repeat melting and pouring several times; the oftener, the better the oil will be. After you have done this, and the heat of the lead has extracted both the greasiness and salt of the oil, take the lead out, and put the oil into a glass; fling three pound of filings of lead into it, shake it well together; pour it afterwards on a colour stone, grind it together as painters do their colours, put it again into the glass, to preserve it for use: the lead will sink to the bottom, and the oil swim a top, which you may use in the following manner.

Take some of it in a bit of cloth, on which there is some of the before-mentioned powder, and rub the rust of spots upon armour or any other iron work therewith, and it will
take

take it clean off: and if afterwards you anoint the armour or iron work with clear oil, it will keep from rust for a long time.

N. B. The emery which is used among the other ingredients of the powder, must be first calcined, which you are to do thus: lay it on a coal fire, and when you see it of a red colour, take it out and beat it in a mortar, and it is fit to be mixed with a rust powder.

Another.

FRY a middling eel in an iron pan, and when brown and thoroughly fried, express its oil, and put into a phial, to fettle and become clear, in the sun. Iron work, anointed with this oil, will never rust, although it lay in a damp place.

To etch upon either SWORD or KNIFE-BLADES.

To prepare the etch-water.

TAKE mercury and aqua fortis, put them together into a glass, till the mercury is consumed, and it is fit for use.

To make the ground.

TAKE three ounces of red lead, one ounce of white lead, half an ounce of chalk, all finely pounded; grind these together with varnish, and anoint your iron therewith; let it dry in the sun, or before a slow fire, and with a pointed steel or needle draw or write on it what you please, and then etch it with the above prepared water.

Another water to etch with.

TAKE two ounces of verdgrease, one ounce of burnt allum, and one ounce of dissolved salt: boil this mixture in one quart of vinegar, till it is half boiled away, and

K 3

when

when you are ready to etch, warm, and pour it with a spoon or glass cup over your work; hold it over the fire to keep it warm, and repeat this till you find it etched deep enough.

To etch 100 or more knife-blades at once.

GRIND red lead with linseed oil or varnish; with this wipe your blades all over, and let them dry well and harden; then write or draw with a pointed bodkin whatever you will: then put them at some distance from each other, into a glass or well glazed pot or pan; dissolve some vitriol in hot water, pour it over the blades, and lute the glass or pot; set it over a gentle coal-fire, let it boil for some time, and then let it cool; then take your blades out, scrape the red lead off, and you will find the etching to your satisfaction.

To make blue letters on sword blades.

TAKE the blade, hold it over a charcoal fire till it is blue, then with oil colours write what letters you will upon the blade, and let them dry; when dry, take good strong vinegar, make it warm, and pour it all over the blade, this will take off the blue colour; then wet your oil colour with fresh water and it will come off easily, and the letters drawn therewith, remain blue.

To harden fishing hooks.

AFTER you have (of good wire) made your small fishing hooks, you must not put them into the fire to harden, but lay them upon a red hot iron plate, and when they are red, fling them into water; take them out again, and when dry, put them again on the hot iron plate, and when they appear of an ash colour, fling them again into cold water; this will make them tough, otherwise they will be brittle.

To gild upon iron or steel.

TAKE common salt, saltpetre and allum, an equal quantity of each, dissolve them in as little warm water as possible; then filter them through a whited brown paper, add
leaf

leaf gold, or rather thin beaten gold to it, and set it on hot sand to make it almost boiling hot; keep it in that heat for 24 hours, and if the water evaporate, you may supply it with more; but at last let it all evaporate, and it will turn to a yellow salt; this pulverise; put it into a glass, and cover it with strong brandy, or spirit of wine, two inches high above the powder: then stop your glass close, put it into a gentle warmth, and the brandy, or spirit, will extract all the gold, and be of a beautiful colour. With this water you may, with a new pen or pencil, write or draw what you please upon a sword-blade, knife, or any other thing made of iron or steel, and it will be gilded to a high colour.

A ground for gilding steel or iron.

TAKE five ounces of vitriol, two ounces of galiz-stone, two ounces of sal-armoniac, one ounce of feather-white, and a handful of common salt: beat all this together until it is fine, and mix it well; put it into a glazed pipkin, add to it a quart of water, and give it a quick boiling; then take a knife, or any other iron that is clean, and stir it about; if it is of a copper colour it is right, but of a red colour it is better.

If you have a mind to gild with this ground, put your steel on a slow fire, and make it so hot that you cannot bear it in your hand; then take your ground, and dipping some cotton into it, wipe the steel with it; take afterwards quicksilver and wipe your ground over, then take the prepared gold, and lay it on such places as you would have gilded; after you have done this, lay it on a charcoal fire until it turns yellow; then wipe it over with tallow, and take cotton to wipe your blade, holding it all the while over the fire until it inclines to a black; rub it with a woollen cloth until that colour vanishes, and rub it again with chalk until you bring it to a fine gloss. If you would have the ground brown or blue, hold it over the fire until it turn either to the one or the other colour; then wipe it over with wax, and polish it with chalk.

Of LEAD and PEWTER.

To make pewter hard.

TAKE one pound, or what quantity you please, of pewter, and let it melt in an iron pan; add to it some fallad oil, let it evaporate well, and stir it continually, keeping the flame from it; add to this some fine wheat flour, and stir it well about; then take all the burnt matter off the top, and to each pound of tin add three or four ounces of plate brass, cut in small pieces, mixed with oil, and a few ounces of pulverised bismuth, or regulus of antimony; stir it all the while, and when all is melted and incorporated, you will not only have a pewter that is harder and whiter, but also different in its sound from common pewter. *Or,*

MELT tin in an iron pan, strew colophoni, or rosin, with fine wheat flour mixed together, into it, and stir it gently about; this takes off the blackness and makes it of a fine white colour.

If you would have it hard, add to each pound of tin one or two ounces of pulverised regulus of antimony and veneris; this makes it white, hard, and gives it a clear sound.

Another method to make pewter as white as silver.

TAKE clean copper one pound, and let it flux; add to it of the best *English* pewter one pound, and continue the flux; to this add two pounds of the regulus of antimony and martis, and let it still flux for half an hour; then cast it into an ingot. Beat this in a mortar to a fine powder, and fling thereof as much into the melted tin as you think requisite: you will find it (after you cast it) of a fine silver colour, it will be hard and give a fine sound: to make it flux the better, you may add a little bismuth. *Or,*

MELT

MELT one pound of copper, add to it one pound of tin, half a pound of zink, one pound of *reg. antim. & martis*; let them flux for half an hour, and cast them into an ingot.

N. B. The *German* author says, there are many more secrets relating to whitening and hardening of pewter, but thinks it not proper to divulge them; and adds, that he has found by experience, that the *reg. antim. & veneris* is better for that use than the *reg. antim. & martis*, because the last will turn the pewter in time to a dirty blue; whereas the former will make it continue white, hard, and of a good sound.

To make tin or lead ashes.

TAKE which sort of these metals you will, let it melt, and fling well dried and beaten salt into it; stir it well together with an iron ladle, or spatula, until it separates and forms itself into a powder. *Or,*

AFTER the tin or lead is melted, pour it into fine dry salt, stir it together until it is fit for sifting: then put this powder into a pan of clean water, and stir it; pour off the first water and put fresh to it; repeat this so often until the water comes off clear, and without the taste of any salt. The remaining powder put into a melting pot, set it in a reverberatory furnace, stir it well together, and you will have fine white tin ashes.

A gold colour upon lead or tin.

TAKE saffron, as much as you will, and put it into strong gum water; add to it a third part of vinegar, and let it soak over night; then mix it with a little clarified honey, stir it well together, and let it boil until it comes to the consistence of honey; strain it afterwards through a cloth, and it is fit for use. *Or,*

TAKE linseed oil skimmed over the fire, and add amber and hepatic aloes, of each an equal quantity; set it over a fire and stir it until it is thick; then cover it all over with earth,

earth, for three days. If you anoint your tin or pewter there with, it will have a fine gold colour.

A water to tin all sorts of metals, but especially iron.

TAKE one ounce of fine pounded sal-armoniac, and put it into very four vinegar, and when you would tin iron wash it first with this vinegar, and strew beaten rosin over it; dip it into the melted tin, and it will come out with a fine and bright lustre.

To make tin which shall have the weight, hardness, sound, and colour of silver.

TAKE fine long crystal antimony, beat it fine, and wash it in water until it becomes sleek, and let it dry again.

Then take well dried saltpetre and tartar, of each an equal quantity, beat them fine, and put them together into an earthen pan, on which lay some live charcoal, and the saltpetre and tartar will soon begin to fulminate: then cover the pan with a lid, let the matter burn out and cool, and you will find a yellow salt: this salt beat to powder before it is quite cold, and put thereof, into a crucible, one pound, and of the washed antimony two pounds. Mix them well together, and let it flux in a wind furnace for three quarters of an hour: then fling a little lighted small coal into them, let them consume and stir them well together with a stick. Presently after take the crucible out of the fire, beat it a little down to the bottom and let it cool of itself; then break the crucible, and you will find a silver coloured regulus of three quarters of a pound weight.

Then take two pounds of old copper, cut it fine, Neal it, and quench it, ten times running, in very strong lee made of the above tartar and rain water. Take it, while wet, and put it into a crucible, with one pound of fine beaten arsenick, *stratum super stratum*. When all is in the crucible, pour as much linseed oil on it as will cover the matter; then cover and lute your crucible, put it into a new pan, fill it all round with sand, and set it three hours in a circular-fire: after it is cold, open it, and you will find the copper spongy and of several colours. Of this take two pounds, and plate-brass two pounds,

pounds, melt these together; add, by degrees, the copper, and give it a quick fusion in a wind furnace: then add two pounds of *English* pewter, half a pound of bismuth, and two pounds of the above regulus; let it flux well, then pour it out, and you will have a fine silver mixture. Beat this into a fine powder, mix it with linseed oil to a paste, and with a spatula add it to the melted pewter; stir it well together, and you will have a fine tin, which will resemble silver in every thing except the test.

To make tin flow easy.

TAKE rosin and saltpetre, of each an equal quantity, beat them to powder, and strew them upon the tin when in fusion.

A particular method to make tin resemble silver.

MELT four ounces of fine plate-brass, add to it four ounces of fine clean tin, and when it is in fusion, add four ounces of bismuth, and four ounces of *regul. antim.* let this flux together, and pour it out into an ingot; then beat it to powder, grind it with rosin and a little sal-armoniac, and with turpentine form it into balls; let them dry in the air, and when you would use them, beat them fine, strew the powder thereof upon the melted tin, stir it well together, and continue putting the powdered balls upon the tin, until you perceive it white and hard enough: of this tin you may draw wire for hilts of swords, or make buttons; it will always retain its silver colour.

Solder to solder tin with.

TAKE tin and lead, of each one ounce; bismuth two ounces; melt these, and pour them over a plate to cast them thin: with this you may solder over a candle or a small charcoal fire.

Another

Another solder for pewter.

TAKE rosin and oil, let them melt in a spoon, and fling into them a little devil's dung, then pour them out; and having new filed the two broken pieces, anoint them with the rosin, dust some fine filed tin over it, and hold it over a coal-fire, and when it flows, take it off and let it cool.

To make tin coat-buttons, in imitation of worked buttons of gold and silk.

TAKE lampblack, grind it with oil of spike, and mark the ground-work with a pencil: when dry, draw it all over with the varnish before described: the best way to imitate worked buttons is, to do them in a fine mould, either stamped or cast, the ground first filled up with black, blue, red, or any other colour; then the raised part is to be wiped very clean, and when dry, to be drawn over with the varnish, which will make it look much finer than what can be done upon a plain button.

For a brown colour take umber.

For green take distilled verdegreafe, mixed with other colours, to make it either deeper or lighter.

For grey, take white lead and lampblack.

All your colours must be ground with oil of spike.

In this manner you may embellish some pewter with a coat of arms, a cypher, or ornaments; I mean such pewter things as are not to be scowered.

The art of making tin plates, or latten.

THERE are only certain sorts of iron which can be reduced in leaves for that purpose; the best is that which, when heated, is easiest extendible, and can be forged with a hammer when cold: the more soft and exceeding flexible, as well as the more brittle, are to be rejected. These leaves are drawn from bars of iron about an inch square, which being made a little flat they cut into thin pieces, which they fold together into parcels, each parcel containing about 40 leaves, which they batter all at once with a hammer of 6 or 700 lb. weight. After this, the principal of the whole art is to prepare these leaves, for the least dust, or rust upon their surface, will hinder

hinder the tin from uniting with them : this indeed might be taken off by filing, but that being both too tedious and expensive, there is a way to it by steeping them in a acid water for a certain time, scowering them with sand when taken out ; by which method a woman can clean more plates in an hour, than an expeditious workman can file in several days. This water, which is kept a mighty secret, is nothing else but common water, made eager with rye, which requires very little pains, for after they have ground the grain grossly, and pounded it, they leave it to ferment in common water for a certain time, and with a little patience they are sure to have an eager menstruum : with this they fill troughs or tuns, into which they put piles of iron plates, and to make it grow eager the better, and have more activity, they keep these vessels in vaults or stoves, which have a little air, and in which they keep lighted charcoal ; the workmen go into these vaults once or twice a day to turn the plates, to take out such as are sufficiently cleansed, and put others in the room : and as the liquor is more acid, or the heat of the vault or stove more intense, the plates are sooner cleansed, but it requires at least two days, and sometimes a longer time. This is the method the *Germans* use for preparing the iron plates for tinning. In *France* they go another way to work ; they dip the iron plates in acid menstrooms, as in water wherein allum, common salts, or sal-armoniac are separately dissolved, and instantly expose them to the air, in order to rust. After two days, during which every plate had been dipt into the menstruum twice or thrice, they are scoured. These menstrooms, tho' weak in themselves, produce the effect as well as the stronger, which are much dearer ; among the latter, vinegar is the most effectual, especially if you dissolve a little sal-armoniac therein, about a pound or two in a puncheon ; by this means the iron rusts sooner than with any other salt, but it must be used very moderately, and the leaves be left to steep in clean water, to dissolve any particles of it that may stick to it's surface, which may otherwise make it rust after it has been tinned.

In the preparation of the plates it must be observed, 1. That in battering them, each parcel receive the immediate action of the hammer in it's turn, otherwise they will not extend equally. 2. To steep them in clay or fullers earth, tempered with water before you heat them, to prevent their foldering with one another.

Whether

Whether you make use of the *German* or *French* way, in preparing your plates, it is absolutely necessary, after the plates are sufficiently scaled, to scower them with sand, and when there remain no more black spots on their surface, to throw them into fair water to prevent their rusting again, where let them remain, 'till you are ready to tin them; the manner of doing it is this: flux the tin in a large iron crucible, of the figure of a broken pyramid with four sides, of which two opposite ones are less than the two others: this crucible you heat from below, the upper rim you must lute quite round in the furnace: the crucible must be deeper than the plates are long, which you dip in downright, so as for the tin to swim over them. The tin being melted in the crucible, you cover it with a layer of a sort of fuet, an inch or two thick, thro' which the plate must pass before it comes into the tin, the use of this is to keep the tin from burning: the common unprepared fuet will render the success of the work uncertain: wherefore you prepare it by first frying and then burning it, which not only gives it a blackish colour, but puts it into a condition to give the iron a disposition to be tinned, which it does surprisngly.

The tin itself must have a certain degree of heat; for if it is not hot enough, it will not stick to the iron; if too hot, the coat will be too thin, of several colours, and a dirty yellow cast. To prevent this, you must make an essay with small pieces of the scaled plates, and see when the tin is in proper order. However, you dip the plates into tin that is more or less hot, according to the thickness you'd have the coat thereof: some plates you only give one layer, and these you plunge into tin, that has a lesser degree of heat than that into which you plunge those which you would have take two layers: when you give these plates the second layer, you put them into tin that has not so great a degree of heat as that into which they were put the first time. Observe, that the tin which is to give the second coat, must be fresh covered with fuet, but only with the common sort without preparation: for, melted tin is sufficiently disposed to attach the new tin to be joined.

To

To gild upon tin, pewter, or lead.

TAKE varnish of linseed oil, red lead, white lead, and turpentine; put them together into a clean pipkin, and let them boil; then grind them upon a stone, and when you would gild pewter, take a pencil, draw the liquid thin upon what you would gild, and lay your leaf gold upon it; or instead of that *Augsburg* metal, and press it with cotton to make it lie close.

Another method to gild pewter, or lead.

TAKE the white of an egg, and beat it clear; with this wipe your tin or pewter, which must be first warmed before a gentle fire, in such places as you design to gild; lay on your leaf gold quick, and press it down with cotton.

The juice of nettles is also fit for that use, and rather better than the egg-clear.

Another method to gild pewter.

TAKE leaves of staniol, and grind them with common gold-fize; with this wipe your pewter or lead over; lay on your leaf gold, and press it with cotton: it is a fine gilding, and has a beautiful lustre.

A method to gild with pewter, or lead leaves.

THIS may be done several ways, but the best is to take white lead, ground with nut oil, with this lay your ground on what you design to gild, let it be wood or any thing else, then lay on your gilded tin leaves, press them down with cotton, or a fine rag, and let it dry; when dry, polish it with a horse's tooth or polisher, and it will look as if it had been gilded in fire.

To gild lead.

TAKE two pounds of yellow ochre, half a pound of red lead, and one ounce of varnish; with which grind your ochre, but the red lead grind with oil, and temper them both together;

together ; lay your ground with this upon the lead, and when it is almost dry lay on your gold ; let it be thorough dry, then polish it.

Some Experiments relating to COPPER and BRASS.

To make brafs.

THIS is done by mixing and melting copper and calamine together : calamine is dug in mines about *Mendip*, &c. in the *West of England* ; it is burnt and calcined in a kiln made red hot ; then it is ground to a powder, and sifted to the fineness of flour, and mixed with ground charcoal, because the calamine is apt to be clammy, to clod, and not so apt to incorporate ; then they put 7 pounds of calamine into a melting pot that holds about a gallon, and about 5 pounds of copper, uppermost ; this is let down with tongs into a wind furnace, one foot deep, wherein it remains 11 hours, one furnace holds eight pots ; after melting it, it is cast into lumps or plates.

To melt copper and brafs, and give it a quick fusion.

TAKE saltpetre, tartar and salt, beat them together very fine ; when you see that your metal begins to sink with the heat, fling a little of this powder into it, and when melted, fling again a little into it, and when you observe it in fusion like water, fling a little again a third time : to twenty five pound of metal fling about a walnutful of powder, and your copper or brafs will cast easily, and be of a melleable temper.

To make brafs malleable that is brittle, and apt to crack in the working.

TAKE tartar, saltpetre, and sulphur, pulverise them together, and after you have made your brafs red hot, strew it all over, let it cool of itself.

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A solder for brass.

TAKE one grain and a quarter of silver, three ounces of brass, one ounce of zink, and melt them together; when melted, sling a good quantity of *Venice borax* upon them.

To sink copper which is in aqua-fortis.

TAKE fine milled lead, cut it in little bits, and put it in aqua-fortis which holds copper, and it will precipitate or sink it all to the bottom.

To make copper as white as silver.

PUT your copper into a strong melting-pot, in the midst of a quantity of glass, and set it in a glass furnace to melt; let the copper be covered all over with glass, and the glass will contract the greenness of the copper, and make it look white. If you repeat this several times your copper will be the whiter. *Or,*

TAKE old copper, that has been much used, or been long in the open air and weather; melt it in a strong crucible before a smith's forge, or in a wind-furnace, but take care of the smoak; let it melt a quarter of an hour, or longer, and clear it from the scales that swim at top: then pour it through a whisk, or birch-broom, into a sharp lee, made either of quick-lime and vine-branch-ashes, or salt of tartar, or *caput mortuum* of distilled spirit of nitre, or such like, and the copper will come fine and nice; then take it out of the lee, and let it melt again as before; repeat this four times running, in order to purify the copper, and when the copper is well purified, melt it over again; when it is in fusion, sling two ounces of crystalline arsenick in, by little and little; but avoid the smoak, and tie a handkerchief, moistened with milk, about your mouth and nose: after it has evaporated, or rather before it is done, sling into it two ounces of silver; and when that is melted, granulate it again through a whisk, and melt it again for use. It will be fit to make any thing in imitation of silver. *Or,*

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T A K E

TAKE white arsenick half a pound, saltpetre eight ounces, tartar eight ounces, borax four ounces, glass-gall four ounces; pulverise each very fine, then mix and put them together in a crucible, and let them flux in a wind furnace for an hour or more; then pour them out, and you will have a whitish yellow substance.

Then take one part of old copper, and one part of old hammered brass, both cut into small pieces; Neal these well, and quench them in lee made of a quart of urine, an handful of salt, four ounces of white powdered tartar, and two ounces of allum: boil them up together, which repeat for ten or twelve times.

When thus you have cleansed the copper and brass, put them together into a crucible, and give them a strong fire in a wind-furnace, or before a smith's forge; let them flux well, and then fling of the above composition, which must be pulverised, one spatula full after another into the crucible, stirring it sometimes about with a stick; to one ounce of copper take an ounce and a half of powder: when all is thrown in and incorporated, then fling a few pieces of broken crown-glass into it, and let it melt; then draw it out again with a pair of tongs, and fling sal-armoniac into it, of the bigness of a walnut, and when it is thoroughly fused, pour it into a casting-pot, and your copper will be of a fine white.

If you take of this copper 24 ounces, and melt one ounce of silver amongst it, letting it flux well with sal-armoniac, you will have a fine mass, which may be worked into what shape, or into any utensil you please, and it will hardly be distinguished from silver plate.

When the silversmith works this composition, he must observe always in the melting, to fling some sal-armoniac into it, to make it malleable; and in hammering he must often Neal it, and let it cool of itself; then hammer it gently, until it is as thin as he would have it; for if it is beat quick in the beginning it will be apt to crack.

The more this metal is nealed and gently hammered, the better it will be. When the work is done, Neal it; then rubbing it with charcoal, and boiling it afterwards three times in a strong lee of tartar, your work will be like silver.

Choice

Choice Secrets for BOOK-BINDERS.

To prepare a lack varnish for book-binders, for French bindings.

FIRST, when the book is covered, either with calf or sheep-skin, or with parchment, it is struck over with a varnish, and spotted with such colours as are taught under the article of imitating tortoisés on ivory or horn; some will spot the leather before they lay on the varnish, and after they have sprinkled their colour, which they commonly make of umber, they lay the varnish over, and polish it with a steel polisher, after which they give it one layer of varnish more, which is the finishing stroke.

French leather for binding of books.

MAKE choice of such leather as is wrought smooth and fine, and strain it on a frame; then having your colours ready at hand, take first of one sort in a pencil made of hog's bristles, and with your finger sprinkle the colour thereof upon the leather; and when you have done with one, you may take another colour, and proceed with as many colours as you think proper: if you would imitate a tyger's skin, dot your colours upon the leather with a stick that is rough at the end, or a pencil; and after it is well dried, lay it over with a *Spanish* varnish, which make in the following manner:

Take a pint of high rectified spirit of wine, of clear gum-fandarac four ounces, clear oil of spike one ounce; pound the fandarac, and put it into the spirit of wine, and then into the oil of spike; let it stand until it is dissolved and settled.

To make white tables for memorandum books, to write upon with a silver bodkin or wire.

TAKE of the finest plaister of Paris, temper it with harts-horn or any other glue; and having strained your parchment tight and smooth in a frame, wipe it over with the

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said mixture on both sides; and when dry, scrape it to make it even; then cover it a second time with the same glue, and when dry, scrape and smooth it as before; this done, take ceruse, grind it fine with linseed oil that has been boiled, and with a soft hair pencil lay it smooth and even on your parchment, or tables; and set it to dry in a shady place, for five or six days; when dry, wipe them over with a damp sponge or linen rag to smooth them, setting them to dry thoroughly until fit for use; then with a sharp edged knife cut the tables what size you please to have them, and bind them fit for the pocket with a little case for the silver bodkin or wire to write with.

To prepare parchment that resembles jaspis or marble.

HAVE a trough made in the manner directed under the article of making marble paper; let it be filled with warm water of gum tragant, and having your colours ready prepared, as will be directed, stir the gum-water with a stick, and put it into a quick circular motion; in the interim, dip your pencil with colour in the center thereof, the colour will disperse and form itself in rounds, as it is carried by the motion of the water; then stir it round in another place, and with a different colour proceed as you did with the first, until your trough is covered with variety of colours. When all is ready, and the water smooth and without motion, then lay on your parchment (which before has been laid between damp paper or cloths) and proceed therewith as you do with marbled paper; hang it up to dry, then smooth and glaze it in the manner you do coloured parchment.

A green transparent parchment.

WASH the parchment in cold lee, until it comes clear from it, then squeeze out the liquor as much as possible; and if you would have it of a fine green colour, take distilled verdegrease ground with vinegar, and add a little sap-green to it, temper it neither too thick nor too thin; then soak your parchment in this colour thoroughly a whole night; rinse it afterwards in water; strain it immediately on a frame, and set it to dry; then take clear varnish, lay it on both sides; set it

it in the sun to dry; after this cut the parchment out of the frame into leaves as large as you please, and lay them in a book under a press to keep them fine and straight; the effect of this parchment is, to make a small letter, when put over it, appear as big again; and it is a great preserver of the eyes, especially to those that read much by candle light.

The varnish must be prepared of linseed oil, and boiled with frankincense, mastick and sandarac.

If you would have the parchment of a clear, transparent, and white colour, only wash, strain, and varnish it as above.

If you would colour it yellow, steep your parchment, after it has been washed, in a yellow liquid made of saffron; for which purpose tie saffron in a thin linen rag, hang it in a weak lee, and let it warm over a slow fire, and when you see the lee tinged yellow it is fit for use.

For a transparent red.

TAKE brasil, as much as you will, put it into a hot lee, which is clear and not too strong, and it will tincture the lee of a fine red; then pour it into about half an egg-shell full of clear wine, draw the parchment through the colour, and when it is as deep as you would have it, strain it as before.

For a blue.

TAKE *Lombard* indigo, grind it with vinegar on a stone, and mix sal-armoniac among it, to the quantity of a pea, with this wet your parchment, and proceed as has been directed for the green.

For a violet or purple colour

TEMPER two thirds of the above red, and one third of the blue, and use it as before directed.

For a black colour.

TAKE *Roman* allum, beat it into powder, and boil it in rain-water to a fourth part; then add *Roman* vitriol, or atrament, with some *Roman* galls, and boil them together;

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with

with this strain your parchment twice or three times over, and when dry lay the *Spanish* varnish over it.

N. B. with these transparent parchments you may make curious bindings; one sort used at *Rome*, is made thus: lay the board, or paste-board, over with leaf-gold, leaf-silver, staniol, metal leaves, &c. then binding the parchment over it, it will give it an uncommon lustre and beauty.

To gild the edges of books.

POUND bole-armoniac and sugar-candy together, and mix it with a proper quantity of the white of an egg well beaten; this done, take the book you intend to gild, which must be well bound, glewed, even cut and well polished, screw it fast in the press, and as even as possible, then, with a pencil give it a wipe with the white of an egg well beaten, and let it dry; then give it another wipe with the above composition, and, when dry, rub and polish it well; and when you will lay on the gold, wet the edges with a little fair water, and immediately thereupon lay on the gold leaves, cut of the size they are to be, pressing them down softly with clean cotton wool, and when dry, burnish it with a dog's tooth.

To make red brasil ink.

YOU must first observe, that when you boil brasil for ink, you ought to do it when the weather is fair, and the sky without clouds or winds, or else your ink will not be so good.

Take quick-lime, pour rain-water on it, and let it stand over night. In the morning pour the clear from off the top through a cloth; and to a quart of this water take one pound of brasil shavings; let them boil half away, and put to it two ounces of cherry-gum, one ounce of gum arabick, and one ounce of beaten allum; then take it, when all is dissolved, from the fire; pour it off the shavings, and put it up for use; you may also add to it a little clear chalk.

To prepare brasil ink without fire.

TAKE a new glazed pipkin, in which put two handfuls of brasil shavings; pour half a pint of vinegar on it, and
let

and let it stand over night, then put to it a piece of allum, as big as a walnut, with a little gum; take also chalk, scraped fine, about one handful, put it gently, by little and little into the pipkin, and stir it well together with a stick, and it will begin to boil, as if it was upon the fire: you must set your pipkin in a clean earthen dish, before you put your chalk in; for as soon as the chalk is in, it will boil over: when this ebullition is over, then put it again into the pipkin, let it stand a day and a night, and you will have a fine brasil ink.

To prepare brasil ink in sticks.

TAKE brasil shavings, or chips, put them in a pan, and proceed in every respect as directed in the foregoing: after the brasil is thus made fit for writing, pour it into shells and set it in the sun, where no dust can come to it, to stand a full hour: then take other shells, pour the top of the brasil out of the first shells into them, and fling the settling away; set these shells also in the sun, and after they have stood an hour, proceed as before; this do till it is quite purified; then boil it to the consistence of wax, put it up in a nut shell, or in a piece of parchment, and you may dilute it with a little wine or fair water, in a little cup, as much as you have occasion for, and write or paint therewith; it is a fine colour, and very fit for colouring maps or prints.

By mixing the brasil ink with a little ground indigo, you have a crimson or purple; and if with a little white lead, you will have a rose colour.

To prepare or extract all manner of lacks out of flowers.

TAKE flowers, of what sort or colour you will; if they stain white paper, when rubbed against it, they are good: with these flowers fill a common, but large head, upon a common cucurbit that is filled with aqua vitæ; put a receiver to it, and lute it well; then distil it over a gentle fire, and the subtil parts or the spirits will fly up into the head, the tincture will be extracted out of the flowers and herbs, and fall into the receiver. This coloured spirit, if distilled in another still, will pass without any colour, and may be used again for the like purposes; but the tincture or colour will remain at the bottom

of the still, which take out and dry at a gentle heat: in this manner you may make the best lack, fit for painters use.

Directions for extracting all sorts of colours out of wood, flowers and herbs.

WHEN mariners are sent in search of dyers drugs, wood, or plants, they are advised by the merchants to try these commodities by chewing them, and see whether they colour the spittle: which if they do, it is a sign they are good, and such tryals may also be made on white paper or linen.

The drugs or plants that are known to be good for extraction of colours are, amongst many others, these: *lignum nephriticum*, or fusticks, is good for yellow and green colour. *Campegiana*, *sylvestre*, &c.

To gild paper.

TAKE yellow ochre, grind it with rain-water, and lay a ground with it upon the paper all over; when dry, take the white of eggs, beat it clear with white sugar-candy, and strike it all over; then lay on the leaf gold, and when dry polish it with a tooth.

Some take saffron, boil it in water, and dissolve a little gum with it; then they strike it over the paper; lay on the gold, and when dry they polish it.

To make indian ink.

BURN lampblack in a crucible, keep it on the fire till it has done smoaking: in like manner burn some horse-chestnuts, 'till no vapour or smoak arises from them. Dissolve some gum tracant to a proper consistence, then mix with it the lampblack and chestnuts, stir it well together, and put that paste into moulds, or form it as you think proper, and then let it dry in a shade.

Another.

PUT five or six lighted wicks into an earthen dish of oil, hang an iron or tin concave cover over it, at a convenient distance, so as to receive all the smoak, when there is a sufficient

cient quantity of soot settled to the cover, then take it off gently with a feather, upon a sheet of paper, and mix it up in the manner above directed.

Note, That the best and clearest oil makes the finest soot, and consequently the best ink.

To prepare blue ink.

TAKE elder-berries, press the juice thereof into a glass, and put powdered allum to it; add to it about its fourth part of vinegar, and a little urine, then dip a rag into it, and try whether the colour is to your liking; you may, if it is too pale, add a little more of the juice; and if too dark, of the vinegar to it.

To make good writing ink.

IT must be observed, that according to the quantity of ink you design to make, the weight and measure of the ingredients must be either augmented or lessened: thus for instance if you would have 10 quarts of ink, you ought to take four quarts of water; six quarts of white wine vinegar; three quarts of white wine, and proportion the rest by weight accordingly.

For a little quantity.

TAKE one pint of water, one pint and a half of wine, one pint and a half of white wine vinegar, and mix all together; then take six ounces of galls, powder'd and sifted thro' a fine hair sieve, put them into a pot or bottle by themselves, and pour on them one half of your mixed liquor; take also four ounces of powdered vitriol, put it into a bottle by itself, and pour half the remaining liquid upon it: to the rest of the liquor put four ounces of gum arabick, beaten fine: cover these three pans, pots, or bottles, let them stand three days, and stir every one of them three or four times a day; on the fourth day put the pan with the galls upon the fire, and when you see that it is almost ready to boil, keep the galls down, and whilst it is warm, pour it into another vessel thro' a cloth; do not squeeze or wring the cloth, but let it run through of itself; then add the liquor which is in the two other

other vessels to it, stir it well together, let it stand three days, stirring it every now and then; the fourth day, after it is settled, pour it through a cloth into a jar or bottle, and you will have good writing ink.

Ink for parchment,

IS prepared in the same manner as the foregoing receipts direct; only to a pint of water, take half a pint of wine and half a pint of vinegar, which together will make one quart of ink. *Or,*

TAKE three or four ounces of powdered galls, and three or four ounces of gum arabick, put them together into a vessel with rain water, and when the gum is dissolved, then strain it through a cloth, and add to it near half an ounce of powdered vitriol. *Or,*

TAKE one pint of beer, put in it one ounce of powdered gall, let it boil till you see it of a reddish colour: then add to it six drams of green vitriol powdered, and let it boil again: when you take it off the fire, add six drams of gum-arabick, and of allum the bigness of a pea, both powdered; stir it till it is cold.

Another receipt for writing ink.

TAKE five ounces of galls, six ounces of vitriol, four ounces of gum, and a fresh egg, a little powder of walnuts, two gallons of beer, and put them into an earthen pot; add a little sal-armoniac, to keep the mixture from moulding. *Or,*

TAKE for one quart of ink, one pint and half a quarter of water, half a quartern of wine, half a quartern of good vinegar, four ounces of vitriol, four ounces of galls, both powdered by themselves; then mix them together in a glazed vessel, and pour the aforesaid liquor upon it, stir it often, during six days or more, and when settled, pour it into a bottle, and you will have very good ink.

To

To make ink powder.

TAKE peach or apricot stones, sweet or bitter almonds, burn them to a black coal in an iron ladle or fire shovel; take likewise rosin of a pine tree, put it in a ladle, and make it flame and burn, catching the smoak in a little skillet or a linen canopy you put over it, which after the rosin has done burning, you wipe the smoak on a white paper, and put it up for use, but to save that trouble you may use lamp-black; take of the said smoak or lamp-black one part, of the coals burnt of the stones, one part, of vitriol one part; powder of galls, which first you fry a little in a ladle with a little oil, two parts; gum-arabick four parts: let all be well mixed and pounded together, and then keep this powder in a leather bag for use, and the older it is the better it will be; when you have occasion to use it, temper a little of it with wine vinegar, or water made hot, if you can have it conveniently, if not, you may make shift with cold. This powder put into pale ink, will immediately make it black and of a fine gloss.

To prepare red ink.

TAKE two ounces of fine brasil chips; the whites of 12 eggs, and the quantity of a hazel nut of allum; beat the whites of the clear eggs; put them all together in the sun, or before the fire; stir them sometimes about; strain them through a cloth and let the juice dry well; then keep it from dust, and when you would use it, only temper it with fair water. *Or,*

TAKE the best fernumbuca, put it into a cup or pot that is glazed, pour good wine vinegar over it, let it stand three or four hours to soak, then take beer that is clear and bright, mix it with clear pump-water, about an inch above the chips; set it on a gentle fire, let it boil, and take care it does not boil over; after it has boiled some time, add powdered allum, the quantity of a walnut, to it, and as much gum arabick, set it again upon the fire, and let it boil; after it has boiled a little, take it off, and strain the liquor from the chips; put it into a glass, close it up, and you will have a fine red ink.

If

If, instead of allum, you put a little sal-armoniac to it, 'twill make the ink look bright.

Yellow ink.

TAKE the leaves of yellow cowslip flowers, that grow common in the fields, squeeze out the juice, and mix it with allum :

Saffron-water with a little allum makes likewise a good yellow. *Or,*

MIX a little allum to some saffron and water, which makes a very good yellow ink.

To write letters, or any thing else, either with gold or silver.

TAKE flint glass or crystal, grind it to powder, temper it with the white of an egg; write with it, and when it is dry, take a gold ring, or a silver thimble, or any piece of either of those metals, rub your writing therewith gently over, and when you see the gold or silver strong enough, glaze it over with a tooth.

To make letters of gold or silver embossed

TAKE the juice of garlick, mix it with writing ink, or rather with a red or yellow colour for gold. Write therewith your letters or ornaments on vellum or paper, when dry repeat going over them again, so as to give them a body; then let it dry; when you lay the gold leaves on, warm the letters with your breath, and close the gold with cotton upon them, it will have a good effect.

A rare secret to prepare gold the ancient way, to paint or write with.

TAKE leaves of gold, put them in a clean pipkin on the fire so as to heat; in another pipkin put four times the weight of the gold near the fire to warm it; this done take both pipkins off the fire, pour the quick-silver upon the gold leaves, and immediately stir it together with a little stick, put
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it into a dish full of fair water, and you will have an amalgama, which you may work with strong vinegar or the juice of lemons on a flat stone, in order to incorporate it the more, then you knead and wash it well with fair water, and strain it thro' a lamb's skin to bring out the quick-silver; then take what remains in the skin, and put to it half as much powdered brimstone, mingle it with the said paste, and set it on the fire, in an iron ladle or crucible, leaving it so till the brimstone is burned, and all the rest is of a yellow colour; then let it cool, putting it into a dish, and washing it with fair water, 'till you have a fair colour of gold; then put it up in a glass phial, and when you have occasion to use it, dilute with a little rose water mixed with a little gum arabick; and you may paint or write with it as you please; when dry burnish it with a dog's tooth, and it will be of a fine lustre.

To write with gold by a pen.

TAKE 16 leaves of the finest gold, put it upon a colour-stone, sprinkle a little vinegar over it, and let it lie for a little while, then grind it with your muller to a fine powder, put this into a mussel shell, with as much clear water as will fill it, mix it together with your finger, then let it settle, and after that pour off the water, and supply it with clear water again, stir it well with your finger, as before; repeat this 'till you see the water come off from the gold as clear as when put on; after you have thus cleared your gold, temper as much as you have occasion for, with a little clean gum water, till you see it will easily flow from your pen; after your writing is dry, glaze it gently with a tooth.

Fine red ink of vermillion.

TAKE vermillion, grind it fine with clean water, and put it up to keep from dust; when you would use it, take as much as you think you shall have occasion for, and dilute it with a little gum water. *Or,*

TAKE half an ounce of vermillion, or prepared cinnabar, put it into a galley-pot, take a little powdered clear gum arabick, dissolve it in water, and temper therewith your vermillion;

vermillion; you may add a little of the white of an egg to it, which beat up till all becomes a scum, and when you let it stand, the settling will be like clear water, which is fit for use.

An artificial water for writing letters of secrecy.

TAKE vitriol, finely powdered, put a little thereof into a new ink-horn, pour clean water on it, and after it has stood a little, write therewith either on vellum or paper, and the writing cannot be seen any other way, than by drawing the letter through a water, which is thus prepared: take a pint of water, put it into one ounce of powdered galls, temper it together, and strain it through a cloth, put the water into a dish that's wide enough and draw your writing through it, and you will read it as you do other writings; and to make the secret contents less liable to suspicion, you may write on the contrary side of the paper or parchment with black writing ink, matters of less consequence.

Another secret, to write a letter white upon white, which cannot be read but in fair water.

TAKE clean allum, beat it to a fine powder, mix it with water, so as not to be too thin; then take a new pen, and with this mixture write what you please upon paper, and let it dry: then let him, who is to read it, lay the letter into a flat basin or dish, that is filled with clean water, and in a quarter of an hour the letters will appear white upon white, so that they may be plainly seen and read. Or,

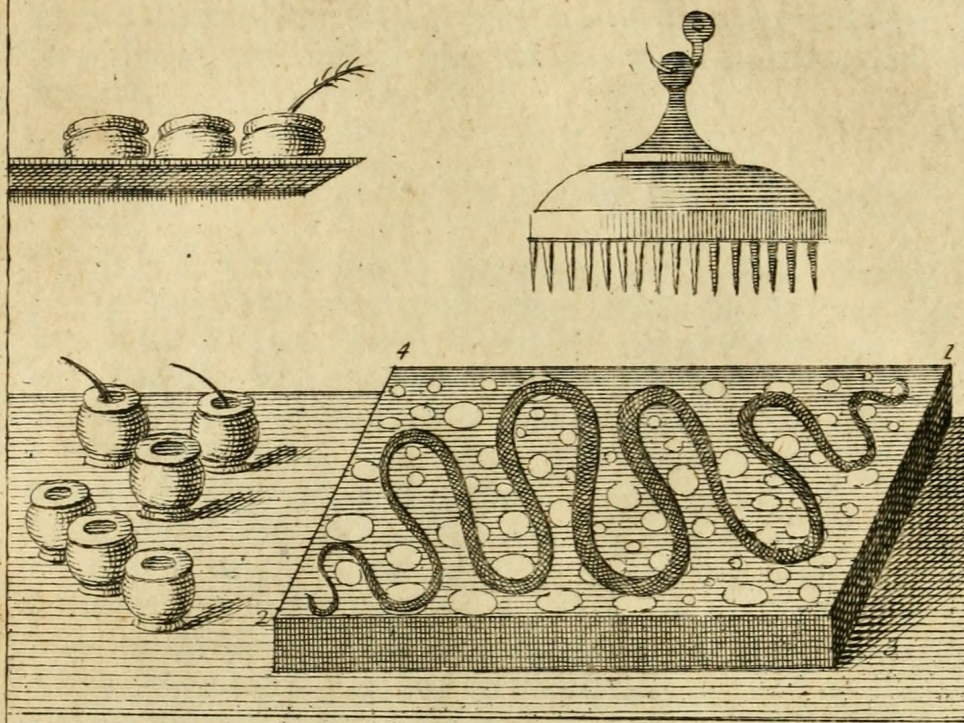
TAKE the juice of onions, write with it; he who would read it, must hold it over the fire, and the writing will turn of a reddish or brownish colour.

The manner of marbling paper or books.

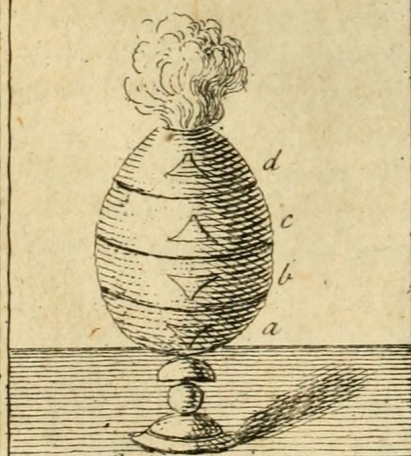
TAKE clear white gum tragant, put it into an earthen pan, pour fresh water to it, till it is two hands high over the gum, cover it, let it soak 24 hours, then stir it well together; add more water to it; keep it often stirring for a whole

PLATE .V.

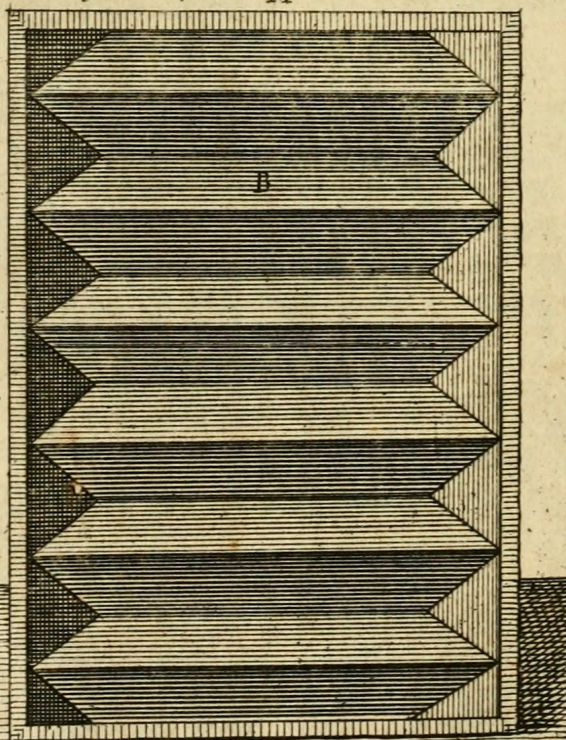
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whole day, and it will swell; keep it stirring several days according as you find your gum is fresh or stale, for the fresh will dissolve sooner than that which has lain by a long time. Keep it now and then stirring; when you find it well dissolved, pour it through a cullendar into another pan, add to it more water, and after it has stood a little, and been stirred about, strain it through a clean cloth into another clean pan; keep it well covered, to hinder the dust or any other thing from coming to it: this water, when you go to make use of it in marbling your paper or books, must be neither too thick nor too thin; you may try it with your comb, by drawing the same from one end of the trough to the other; if it swells the water before it, it is a sign that it is too thick, and you must add in proportion a little more water.

Your trough must be of the largeness of your paper, or rather something wider, and about four inches deep.

After you have filled your trough with the aforementioned water, and fitted every thing for the work, then (before you lay on your colours) take a clean sheet, and draw the surface, which will be a thin sort of film, off on it; then have your three colours, namely indigo mixt with white lead, yellow ochre, and rose pink, ready prepared at hand, and for each colour have two galley-pots, in order to temper them, as you would have them in different shades.

All your colours must be ground very fine with brandy.

The blue is easily made deeper or lighter, by adding more or less white lead,

The yellow used for that purpose, is either yellow orpiment or *Dutch* pink.

For blue, grind indigo, and white lead, each by itself, in order to mix that colour either lighter or darker.

For green, take the aforesaid blue and white, add some yellow to it, and temper it darker or lighter, as you would have it.

For red, take either lake, or rose pink.

Every one of these colours are, as we said before, first ground very fine with brandy, and when you are ready to go to work, add a little ox or fish-gall to them; but this must be done with discretion, and you may try them by sprinkling a few drops upon your gum water; if you find the colour fly and spread too much about, it is a sign of too much gall, which to remedy,

add

add more of the same colour which has none, but when you see the colour spread and retract itself again gently, it is right.

When thus you have your colours, and all things in good order, then take a pencil, or the end of a feather, and sprinkle or put first your red colour; then the blue, yellow, green, &c. begin your red from No. 1, and go along your trough to No. 2; also the blue from No. 3, all along to No. 4. The yellow and green put here and there in the vacant places; then with a bodkin or small skewer, draw a sort of a serpentine figure thro' the colours, beginning from No. 1, to No. 2: when this is done then take your comb and draw the same straight along from No. 1, to No. 2. If you would have some turnings or snail-work on your paper, then with a bodkin give the colours what turns you please. See the plate.

Thus far you are ready in order to lay on your paper, which must be moistened the day before, in the same manner as book-printers do their paper for printing; take a sheet at a time, lay it gently upon your colours in the trough, press it slightly with your finger down in such places where you find the paper lies hollow; this done, take hold at one end of the paper, and draw it up at the other end of the trough, hang it up to dry on a cord, when dry, glaze it, and it is done. You may also embellish your paper with streaks of gold, by applying muffled gold or silver, tempered with gum-water, among the rest of the colours.

To silver paper, after the Chinese manner, without silver.

TAKE two scruples of clear glue, made of neats leather, one scruple of white allum, half a pint of clean water; simmer it over a slow fire 'till the water is consumed or the steam ceases: then your sheets of paper being layed on a smooth table, you dip a pretty large pencil into that glue, daub it over as even as you can, repeat this two or three times, and then you sift the powder of talk through a fine sieve made of horse-hair or gauze, over it, and then hang it up to dry, and when dry, rub off the superfluous talk, which serves again for the same purpose: the talk you prepare in the following manner.

Take

Take fine white transparent talk, that comes from *Muscovy*, boil it in clear water for four hours, then take it off the fire and let it stand so for two days: then take it out, wash it well, and put it into a linen rag, and beat it to pieces with a mallet: to 10 pounds of talk, add three pounds of white allum, and grind it together in a little hand-mill, then sift it through a gauze sieve, and being thus reduced to a powder, put it into water and just boil it up. Then let it sink to the bottom, pour off the water from it, place the powder in the sun to dry, and it will become a hard consistence. This beat in a mortar to an impalpable powder, and keep it for the use above mentioned, free from dust.

To prepare ink, so that what is writ therewith cannot be read but in a dark place.

TAKE half a pint of goat's milk, a sweet apple peeled and cut, a handful of touchwood, which in the night-time seems to shine; put this and the apple into a mortar, beat them together, pouring now and then a little of the goat's milk to it; after this is well beaten, pour the rest of the milk to it, stir it well together, then wring it through a cloth, with this liquor write what you please, and if you would read it, go into a dark cellar or chamber, and the writing will appear of a fiery or gold colour.

To make fine red paper.

TAKE a pan full of water, put some quick-lime into it, to make it into a lee, and let it stand over night; then put brasil chips into a clean pot, about half full, fill it with the leet and boil it to half, and when it is just hot, add to it a little allum; when you would use it, mix it with a little gum or size, and then with a pretty large pencil lay your colour on the paper with an even hand.

To prepare ink for drawing of lines, which, when writ upon, may be rubbed out again.

BURN tartar to ashes, or until it is calcined, to a white colour; take thereof the bigness of a hazel-nut, and lay it into a cup full of water to dissolve, then filtrate it: to his

M

solution

solution mix as much fine ground touch-stone as will colour it black enough to write with; with this ink rule the lines you would write upon: when you have done writing, only rub it over with the crumb of a stale roll, or with crumb of bread; the lines will vanish and the paper be as clean as it was before. This may be useful at schools.

To write so that the letters may appear white, and the ground of the parchment black.

TAKE clean water, temper it with the yolk of an egg so as to write therewith; with this write upon your vellum, or parchment, what you please; let it dry, and draw it through ink, so that it may take every where; or strike it over with a large soft pencil to make it of a good black; when it is thorough dry, then scrape it gently off with a knife, and your writing will appear as white as the parchment was before you wrote upon it.

To make oil paper.

TAKE the shreds of parchment, boil them in clear water until it is clammy and like a strong glue, strain it through a cloth, and with a large pencil strike it over the paper; when dry, varnish it over with a varnish of turpentine, or the *Spanish* varnish mentioned in the first article under this head.

Choice Secrets for CABINET MAKERS and TURNERS.

To prepare a black colour for staining wood.

PUT two ounces of iron filings into a new earthen pan; add to it one ounce of sal-armoniac, dissolved in a quart of vinegar, and let it stand 12 days, the longer it stands the better it will be; then take rasped logwood, and three ounces of gallnuts, pounded fine; infuse this in a quart of lee made of lime; let this also stand the same time as the above.

When

When you have occasion to use it, warm both those liquors over a slow fire, and with the lee first strike the wood over you design to dye, and then with vinegar; repeat this until you see the wood black enough to your liking; after which, wax the wood over with bees-wax, and rub it with a woollen rag, and it will look bright and fine.

To imitate ebony wood.

TAKE clean and smooth box, boil it in oil until it turns black. *Or,*

Take smooth plained pear-tree wood, strike it over with aqua fortis, and let it dry in a shady place in the air; then wipe it over with good black writing ink, let it also dry in the shade; repeat and wipe the ink over it until the black is to your liking. Then polish it with wax and a woollen rag.

Another, but more costly method.

DISSOLVE one ounce of fine silver in one pound of aqua fortis; add a quarter of a pint of clear water to it, with this strike your wood over; repeat it until you perceive it to be as black as velvet, then polish it with wax.

Another method.

TAKE what sort of wood you please, box, cedar, mulberry, pear-tree, and the like; steep it for three days in allum-water, in a warm place, or if it be in the summer, in the sun; then boil it to oil, in which mix some vitriol and sulphur; the longer you boil it the blacker the wood will be; however, you must not let it boil too long, lest it should be scorched. *Or,*

STRIKE your wood over with spirit of vitriol, hold it over a coal fire, and repeat this until it is black enough; then polish it. *Or,*

IRON filings steeped in beer and urine, will make a good black. *Or,*

M 2

PUT

PUT one pound of rasped brasil in a clean pan, boil it in three pints of strong white wine vinegar until the half is boiled away, then pour it clear off; take also one pound of bruised gallnuts, put them into another pan with water, and let them stand for eight days in the sun to soak; then put to it eight ounces of vitriol, stir it together, and let it stand for two or three days; pour it off clear; and add to this liquor the fourth part of the prepared brasil, and with this strike your wood over 20 or 30 times running; let it every time dry in the shade.

Then take fine silver, as much as you please, dissolve it in common aqua-fortis, add to it twice the quantity of spring-water; with this strike over the dyed wood once or twice, set it in the air to dry, and it will be of a fine coal black; after which polish it as before directed.

An excellent secret to dye wood of any colour.

PUT fresh horse-dung, the moistest you can get, upon some little sticks lay a cross one another over an earthen pan, which is to receive the liquor that drops from the dung; supplying it with fresh dung every time it is drained until you have a sufficient quantity. Then divide the liquor in as many pots as you intend the colours, put in each pot the bigness of a horse-bean of allum, and as much gum-arabic, then steep what colour you will in that liquor, and put in the pieces of wood, which, after it is stained to your liking you take out dry, the longer you let it remain in the liquor the deeper will be the colour; by this means you may shade your wood from a deep to a light colour, which will penetrate so as never to fade or vanish.

To dye wood of a red colour.

TAKE one handful of quick-lime, two handfuls of ashes; put them together into rain-water, and let them soak for half an hour, until they are well settled, and you have a good lee. Then take a new pan, in which put one pound of fernambuca, pour on it the said lee, and after it has soaked for half an hour let it boil, and when it is cold, pour it off into another clean pan, and fling one ounce of gum-arabic into it; take

take another earthen pan with rain-water, put into it two ounces of allum, boil your wood in it, and after it is well soaked, take it out, let it cool a little, warming, the meanwhile, the red colour, and striking it over your wood; repeat this until your colour is deep enough to your liking, then polish it with a dog's tooth.

Another red for dying wood.

TAKE rasped brasil, boil it until you see it of a fine red colour, then strain it through a linen cloth.

The wood you design to dye, colour first over with saffron yellow, and after it is dry, strike it over with the red colour, until it is deep enough; then polish it with a tooth. If you put a little allum to the brasil colour, it will turn to a brown.

To etch figures upon wood.

TAKE melted tallow, and having your table ready, form therewith flowers, or what else you will, upon it; then, with a coloured water, boiled with vitriol, saltpetre and allum, in standing mist-water, with which cover the board over the tallow; and let it stand, or repeat it until the colour pleases you. In this manner you may marble or cloud your wood as you please yourself.

To marble upon wood.

TAKE the whites of eggs, beat them up until you can write or draw therewith; then with a pencil, or feather, draw what veins you please upon the wood; after it is dried and hardened for two hours, take quick-lime; mix it well together with wine, and with a brush, or pencil, paint the wood all over; after it is thorough dry, rub it with a scrubbing-brush off, so that both the lime and the whites of the eggs may come off together; then rub it with a linen rag until it is smooth and fine; after which you may lay over a thin varnish, and you will have a fine marble wood. Or,

GRIND white-lead, or chalk, together with water, upon a marble very fine, then mix it up with the whites of eggs well beaten, wherewith you may paint or marble as you

M 3

think

think proper; when dry, strike it over with a lee made of lime and urine, this will give the wood a brown-red colour: upon this colour you may, when dry, marble again with the whites of eggs; and again, when dry, give it another brush with the lee; after you have with a scrubbing-brush rubbed off the marbling whites of eggs, then you may strike at once more all over with the lee; and your work, when dry and polished, will look very agreeable and of a fine marbling.

A gold, silver, or copper colour on wood.

TAKE crystal, beat it in a mortar to powder, then grind it on a marble with clean water, and put it into a clean new pot, warm it, and add to it a little glue; with this strike or paint over your wood: when dry, take a piece of gold, silver or copper, and rubbing it over therewith, you will have the colour of any one of those metals upon the wood, which you may afterwards polish.

To colour wood of a walnut tree colour.

TAKE the bark of walnut-trees, or the green shells of walnuts, dry them in the sun, mix as much as you have occasion for with nut oil; boil it up, and rub the wood over therewith.

To stain wood of a fine green.

TAKE green nut-shells, put them into a lee made of Roman vitriol and allum, in which let them boil an hour or two. To this lee add some verdegrease, finely ground with vinegar, then take your wood, after you have soaked it for two days in strong white wine vinegar, and boil it therein. Or,

TAKE the finest verdegrease, grind it with sharp wine vinegar, add to it a little tartar; let it stand over night, the verdegrease will settle, and you will have a fine green; with this strike over your wood several times: if you would have it of a grass green, then put a little sap green amongst it.

A Red

A red colour for wood.

TAKE quick-lime, pour rain-water upon it: let it stand over night, and filter it through a cloth; then add more rain-water to it, and put in clear and fresh brasil chips, together with the wood you intend to dye, and boil it till the colour is to your liking. The wood is first to be thoroughly soaked in allum water. *Or,*

POLISH your wood work, after you have finished it with your plane, and then lay on it mussel gold or silver, diluted with size or with the white of an egg; marbling it in the manner before directed in marbling of wood, and when dry, strike it over several times with the following colour.

Take fine rasped brasil, pour on it oil of tartar, or infuse it therein, and it will extract a fine red colour: this coloured oil pour off, and put fresh oil to the brasil, to extract more of the colour. Let these extractions dry gently, then draw it off again with spirit of wine, and you will have a red for your use.

A violet colour for wood.

TAKE four ounces of brasil, and one ounce of indigo, infuse them together in a quart of water, and boil your wood therein.

To adorn wood with ornaments of silver or tin:

FIRST carve or hollow your ornaments out upon your wood in the best manner, so as to undermine the edges on both sides of your strokes. Then make an amalgama of tin, by dissolving it over a gentle heat, and putting into it the same quantity of quicksilver, which, before you have heated, stir with a stick well together, and pour it into a pan of cold water; when dry, grind it upon a marble with water very fine, tempering it with clear size; then fill up the carved figures, smoothing it with your hand, and when dry polish it. To make it more of a silver colour, rub it over with an amalgama of silver and quicksilver, and polish it with a dog's tooth.

Instead of tin, you may also use bismuth ground fine with water.

M 4

To

To emboss or trace all manner of ornaments on a gilded smooth pannel, the gold being laid over with black or any other colour.

FIRST gild your pannel or other wood work, as you are directed under the article of gilding, and when thoroughly dry, paint it all over smooth and even with lampblack, ground with linseed and nut oil; add to it an equal quantity of umber, in order to dry it the better; after you have set it for two or three days, or according to the conveniency or the time of the year, to dry; then, before it is quite hard, draw or pounce what you design to emboss upon, and with a blunt-pointed bodkin, horn, or wood, trace into the black lay, down to the gold, opening those places, and making the gold appear in the best manner you can. In birds, plants, cattle, and such like, you must observe to take the heightenings out clear, and leave the shade, by hatching into the black, agreeable to your design; the fine and soft shades of the hair, &c. you may finish with a fine pencil, with the black colour, upon the gold; and when you have done, let it dry thoroughly for three or four days more; then lay over it a clear varnish, which you may, after it is dried, repeat a second time, and your work will look beautiful.

To do this upon a blue ground.

AFTER you have gilded your work, then take allum which is not too coarse, mix it with mortar on a marble stone, adding to it the white of an egg: with this and a little water mix your smalt, and strike it fine and even over the gilding: then, when it is almost dry, sift through a fine sieve some of the finest smalt over it: you may, if you will, mix it with spangles of several colours; and when thoroughly dry, wipe off what sticks not to it, and proceed in tracing up your figures you design for gold. The fine finishing strokes upon the gold, because they cannot well be done with smalt, you may use *Prussian* blue or indigo mixed with white lead. You may, if you will, varnish it; but it will look better without.

Varieties

Varieties of GLUES and CEMENTS, for joining not only Wood, but also STONE, GLASS, and even METALS.

An excellent glue for wood, stone, glass, and metals.

TAKE good glue four ounces, soak it over night in distilled vinegar, then boil it up therewith; take a clove of garlic, beat or bray it in a mortar, add to it one ounce of ox-gall. Wring this juice through a linen cloth into the warm glue; then take mastic and sarcocolla, of each one dram, sandarac and turpentine of each two drams: grind the sandarac and mastic fine, and put them together with the sarcocolla and turpentine into a phial; pour one ounce of the strongest brandy upon it, and let it stand three hours in a moderate heat, well stopped up, giving it now and then a shake, add this also to the warm glue; then stir or beat it together with a wooden spatula, 'till some of the moisture is evaporated, and the glue is grown cold. When you have occasion to use it, then take as much or as little as your work requires, soak it in strong vinegar, 'till it is dissolved. If you use this glue for stones, mix it with tripoli, or with some powdered chalk; and if for glass mix besides a little tripoli, fine ground *Venice* glass; and if you would use it for metals, as iron, brass, copper, put to it some of the finest filings; you may also add a little ising-glass. And if you would have this glue hold out or stand the water, mix it up with a strong varnish as much as the present occasion requires.

A good stone glue or cement for grotto-work.

TAKE two parts of white rosin, melt it clear, add to it four parts of bees-wax; when melted together, add stone flour, of the stone you design to cement, two or three parts, or so much as will give the cement the colour of the stone; to this add one part of flour of sulphur; first incorporate all together over a gentle fire, and afterwards knead

knead it with your hands in warm water. With this cement the stones after they are well dried and have been warmed before the fire, in order to receive the cement the better.

A wood glue, which stands water.

COMMON glue mixed up with linseed oil or varnish, applied to the places to be glued together, after they have been warmed, and when thoroughly dry, will last and stand water.

Another fine glue.

TAKE the ising-glass and common glue, soak them overnight in strong brandy; then dissolve them over a coal fire, and mix with it a little fine powdered chalk; this will make a very strong glue.

Another extraordinary glue.

TAKE sal-armoniac, sandarac and gum lacca, soak and dissolve them in strong brandy, over a gentle heat, put to them a little turpentine; when all is dissolved, then pour the solution over ising-glass and common glue, and in a close vessel, dissolve it over a slow fire; add to it a little glass dust, and when it is of a right temper, use it.

A good water cement.

TAKE one part of minium or red lead, and two parts of lime; mix them well together with the whites of eggs.

Stone-glue, wherewith you may glue either stone or glass.

TAKE white flint-stone powder, which is dry and finely searced; then take white rosin, melt it in an iron or earthen ladle, stir the powder in it, 'till it is like a thick paste: warm the glass, or what you design to glue together, gild the places or joinings, and it will add a great beauty. This has been made use of in the embellishment of cabinets and other things.

An

An exceeding fine cement to mend broken china, or glasses.

GARLICK stamped in a stone mortar, the juice whereof, when applied to the pieces to be joined together, is the finest and strongest cement for that purpose, and will leave little or no mark, if done with care.

A cement for broken glasses.

BEAT the white of an egg very clear, mix with it powdered quick-lime, with this join your broken glasses, china and earthen ware. *Or,*

TAKE ising-glass, powdered chalk, and a little lime, mix it together, and dissolve it in fair water over a slow fire, with which cement your broken glasses or china ware, and set it to dry in the shade. *Or,*

TAKE ising-glass, mastick and turpentine, dissolve them, and cement your broken ware; when dry they will hold, and rather break in another place, than where joined and cemented. *Or,*

TAKE quick lime, mix it with old cheese, which before you have boiled in water to a paste; with this cement your glasses or china, and it will answer your desire. This paste is likewise a good *lutum*; to lute a cover to an earthen pan, or a glass, retorts, &c. You may add a little fine brick-dust to it.

A lutum or cement, for cracks in glasses used for chemical preparations. This will stand the fire.

TAKE wheat-flour, fine powdered *Venice* glass, pulverized chalk of each an equal quantity; fine brick-dust one half of the quantity, a little scraped lint; mix it up with the white of an egg, smear it on a linen cloth like a plaister, and with it enclose the cracks of your glass retort, or other glass utensil; but let it dry before you put it to the fire. *Or,*

TAKE old varnish, glue therewith your pieces together, tie it close, and set it to dry in the sun, or a warm place; when

when dry, scrape off the varnish that is pressed out at the sides, and it will hold very well.

To join broken amber.

ANoint the pieces with linseed oil, join and hold them close together over the fire.

An excellent glue or cement to mix with stone, glass, marble, &c. in order to make utensils, images, and other things therewith.

TAKE fine glue well purified, four ounces; mastick two ounces, powdered sealing-wax six ounces, fine ground brick-dust one ounce; put the fish glue into a glazed pipkin upon a slow fire; and after you have mixed your ingredients, put it together into the pipkin, boil it up, and what hangs together, use; if you mix it up with fine powdered glass, of any colour, you may form it to what shape you will, and when cold and dry, it will be as hard as stone.

Another cement, which dries quickly.

TAKE pitch, as much as you will, melt it, and mix it with brick-dust and litharge, and to make it harder, moisten the brick-dust first with sharp vinegar, and take a larger quantity of the litharge, it will be as hard as stone.

Good glue sticks, or spittle glue, fit for bookbinders.

TAKE two ounces of ising-glass, half an ounce of sugar-candy, and half a dram of gum tragant. Then take half an ounce of slips or parings of white parchment, pour on it a pint of water, and let it boil well; take that water, strain it through a cloth, and pour it over the two other ingredients, mixed with a little rose water; let it boil away above half, then take it off the fire, and cast it into little flat sticks, or in any shape you please.

A

A water cement, which the longer it is in water, the harder it grows.

TAKE mastick, incense, rosin, and fine cut cotton, of each an equal quantity, melt, and with some powdered quick-lime, mix them up into a mass.

A cement as hard as iron.

MELT pitch, then take ground sand, worn off from grind-stones, stir them well together, boil it up, and it is fit for use.

Several curious Secrets relating to IVORY, BONE,
and HORN.

To whiten ivory that is become red or yellow.

PUT allum into fair water, so much as will make it pretty white, then boil it up; into this put your ivory for an hour to soak; rub it with a hair cloth, and wipe it over with a clean napkin or linen rag moistened; in this let it lie, till it dries of itself, else it will be apt to split.

Another method to whiten green ivory.

BOIL the ivory in water and quick-lime, till you see it has a good white.

To marble upon ivory.

MELT bees-wax and tallow together, or else yellow and white bees-wax, and lay it over your ivory; then with an ivory bodkin, open the strokes that are to imitate marbling; pour the solution of some metal or other on them, and let it stand a little while; then pour it off, and when it is dry, cover those strokes again with wax, and open some other veins with your bodkin for another metallic solution; and this repeat to the number of colours you design to give it.

The

The solution of gold gives it a purple; of copper, a green; of silver, a lead black; of iron, a yellow and brown colour. These solutions well managed, and applied on ivory, will intirely answer the design of the artist.

By this method you may imitate tortoise-shell, and several other things on ivory.

To stain ivory of a fine green.

TAKE to two parts of verdegrease one part of sal-armoniack; grind it well together, pour strong white wine vinegar on it, and put your ivory into it; let it lie covered, till the colour has penetrated, and is deep enough to your liking. If you would have it marbled or spotted, sprinkle or marble it with wax.

And thus you may colour your ivory with any other colours, if you prepare them in the manner directed, viz. with sal-armoniack and vinegar.

To dye ivory or bone of a fine coral red.

MAKE a lee of wood-ashes, of which take two quarts, pour it in a pan upon one pound of brasil, to this add one pound of allum, two pounds of copper filings, and boil it for half an hour; then take it off, and let it stand: in this put the ivory or bone, the longer it continues in this liquor, the redder it will be.

To stain ivory or bone of a black colour.

TAKE litharge and quick-lime, an equal quantity of each, put them in rain-water over the fire, till it begins to boil. In this put the bone or ivory, stirring them well about with a stick; and afterwards, when you see the bone receive the colour, take the pan from the fire, stirring the bone all the while, till the liquor is cold.

To dye bones of a green colour.

TAKE a pan full of clean water, and put into it a pretty large piece of quick-lime, leaving it so for 24 hours; then stir it well together with a stick, and when settled stir it again,

again, thus repeating it three or four times; the next morning strain it off clean and put it up for use; the bones you intend to dye boil in common water wherein allum has been dissolved for some time, then scrape them well, and put them into the lime water mixt with verdegrease, boil them well, and then take them out to dry; instead of lime water you may make use of urine, which will answer the same purpose.

To dye bones or ivory the colour of an emerald.

PUT copper-filings or flacks into some aqua-fortis, and when it has done working, put in your wrought bone or ivory, leaving it therein for 24 hours, then take it out and it will be of a pleasant emerald-colour.

To dye bones, red, blue, or any other colour.

FIRST boil the bones in allum water, then take quick-lime-water or urine, put into it brasil, lackwood, or madder, or whatever colour you please; then boil the bones or ivory therein, and it will answer your purpose.

To make horn soft.

TAKE man's urine, which has been put by and covered for a month; in this boil one pound of weed-ashes, or the ashes of vine-stalks, two pounds of quick-lime, eight ounces of tartar, and eight ounces of salt; after it is boiled pour it through a flannel, and filter it thus three times. Keep this lee covered, and soak the horn therein for eight days, and it will be soft.

Another.

TAKE weed-ashes and quick-lime; of this make a strong lee, filter it clear, and boil the shavings or chips of horn therein, and they will be like a paste; you may colour it of what colour you please, and cast or form it into any thing you please.

To

To prepare horn leaves in imitation of tortoise-shell.

TAKE quick-lime one pound, and litharge of silver eight ounces; mix it with some urine into a paste, and make spots with it, in what form or shape you please, on both sides of the horn; when dry, rub off the powder, and repeat this as many times as you will. Then take vermilion, which is prepared with size, lay it all over one side of the horn, as also on the wood, to which you design to fasten it.

For raised work, form the horn in a mould of what shape soever: put it by to dry, and with the aforesaid paste and the vermilion give it the colour; then lay on a clear glue (neither too thick, nor too thin) both upon the horn and the wood on which it is to be fixed, and close it together; do this work in a warm place; and let it stand all night, then cut or file off the roughness, or what is superfluous about it; rub it over with a coal, and polish it with tripoli and linseed oil.

The work made in this manner looks very beautiful and natural, and may be used by cabinet makers for pillars, pilasters, pannels, or any other embellishment in cabinet-work.

Another method to counterfeit tortoise-shell on horn.

TAKE good aqua-fortis two ounces, fine silver one dram; let the silver dissolve, and after you have spotted or marbled your horn with wax, strike the solution over it; let it dry of itself, and the horn will be in those places, which are free from wax, of a brown or black colour. *Or,*

Lay the wax all over the horn, then with a pointed skewer or iron draw what you will, laying the figure you draw open on the horn; then pour on the above solution, let it stand a little; and after you have poured it off, either scrape or melt the wax, wipe it with a clean rag, and polish it.

Instead of the silver solution, you may boil litharge of silver in a strong lee made of quick lime, so long till it becomes of a black tincture: or, instead of silver you may dissolve lead in aqua-fortis.

To

To solder horn together, after it has been lined with proper foils or colours.

TAKE two pieces of horn, made on purpose to meet together, either for handles of knives, razors, or any thing else; lay foils of what colour you please on the inside of one of the horns, or instead of foils painted or gilded paper or parchment; then fix the other piece upon it: lay a wet linen fillet, twice doubled, over the edges, and with a hot iron rub it over, and it will close and join together as firm as if made of one piece.

To dye horn of a green colour.

TAKE two parts of verdegrease, one third part of sal. armoniac, grind it well together, pour on it strong white wine vinegar, and it will be tinged of a pleasant green: then put your horn into it, let it lie therein till you see it tinged to what height of colour you would have it. *Or,*

TAKE the green shells of walnuts, put them into a strong lee, with a little vitriol and allum, let it boil for two hours, and lay the horn for two days in strong vinegar; then put half an ounce of verdegrease, ground with vinegar, into the lee, boil the horn in it, and it will be of a fine green.

To dye horn of a red colour.

TAKE quick-lime, pour rain-water upon it, and let it stand; filter it through a cloth, and put to it one quart of clean water, and two ounces of ground brasil-wood; steep the horn therein, then boil it, and you will have a fine red, if before you have soaked it for a while in allum-water.

To stain horn of a brown colour.

TAKE quick-lime, slacken it with urine, and wipe it over the horn; then take red curriers water, wash the horn therein, and it will turn to a green colour; wipe it over again with the same lime, and when dry, wash it with lee; let it lay therein a whole day, it will be of a fine chesnut colour.

N

To

To dye horn of a blue colour.

TAKE a brass bowl, and when you have made it red hot, wipe it over with sal-armoniac; then pour lime water upon it, stir it together, and you will have a blue water, in which steep the horn; the longer you let it lie, the deeper will be the colour.

OF VARNISHING or JAPANNING on WOOD, &c.

A white varnish.

TAKE ten ounces of rectified spirits of wine, and fine pulverised gum-sandarac two ounces, clear Venice turpentine two ounces, put it together into a glass, and cover it close with waxed paper and a bladder; then take a pot with water, put it on a coal fire, and when it begins to be warm, put some hay at the bottom of the pot, on which set your glass; then let it boil for two or three hours, and the sandarac and turpentine will dissolve and unite with the spirits: then pour your varnish boiling hot through a clean hair cloth, and put it up in a clean phial for use. This is an excellent varnish, fit to be used for varnishing light colours, as white, yellow, green, sky, red; also such things as are silvered or gilded:

Another varnish fit to mix with red or dark colours, and to japan the work over therewith.

TAKE rectified spirits, that is, such as when poured on gunpowder will fire it; or when a linnen rag being dipped into it, and lighted it will consume it, one pound; of clean gum lacca a quarter of a pound; grind it fine, and put it into a phial; then pour the spirits over it, let it stand for two days, shaking it once every hour; the third day hang it over a gentle coal fire till it is well dissolved, then strain it through a hair bag, and put it up for use.

Another

Another lac varnish.

TAKE of best and strongest brandy one quart, calcined tartar one pound, let the brandy stand upon the tartar, close covered, for one day in a gentle warmth then pour off the brandy and filtrate it through a paper; of this take one pound, white amber six ounces, sandarac six ounces, gum lac two ounces (the amber must be picked out of the clear pieces) grind all fine together, put it into a phial or matrafs, then pour on it three pound of the filtrated brandy: your phial must be but about half filled; then shake it about for an hour together, keep it in the matrafs for two days, shaking it once every hour; when settled, pour it through a hair cloth, and it is fit for use.

What sediment remains in the phial, may be used in making another such quantity of varnish, adding to it but half the quantity of fresh ingredients.

Another lac varnish.

TAKE highly rectified spirits of wine one pint, gum lac four ounces, sandarac two ounces, white amber one ounce, white frankincense one ounce; powder these in a stone mortar very fine, and put them, together with the spirits of wine, into a phial or matrafs, stopping it very close; set it in the heat of the sun, or in winter-time in a warm place, and after it has stood three or four days, set it on ashes over a charcoal fire, boil it softly for two hours, and when you see the spirits of a yellowish brownish colour, and of a thick consistence, pour it hot through a hair cloth, and preserve it in a clean phial for use.

A white or clear lac varnish.

TAKE gum elemi, gum animæ, white frankincense, and white amber, of each one dram, grind them fine, put them into a glass, and boil them in distilled vinegar: then pour off the vinegar, and wash the sediment with clean warm water, and it will be of a white colour; dry it, and grind it fine again; add to it one dram of gum tragant, two drams

of white sugar candy, both finely ground, put it by little and little into a matrafs, wherein you have before hand put two pound of high rectified spirits of wine; and after you have put all the ingredients into it, shake it for an hour together, then put it into a *balneum mariae*, and when it begins to boil, let it continue so for two hours; then let it cool; and after it is cold let it stand for three days, decant it off into a clean phial, stop it close, and it is then fit for use. Or,

TAKE the above specified ingredients, boil them in vinegar as directed, and after you have put to it the gum tragant and sugar candy, take of clear oil of spike or turpentine one pound, Cyprian turpentine six ounces, put them together into a strong matrafs, and set it, furnished with a leaden ring, in a bath heat; when that heat begins to boil, and the turpentine is dissolved, then add the other ingredients finely ground to it; stir them well together with a wooden spatula, and let them stand in the boiling *balneum* for three or four hours; then take it out, and when cold, and it has stood two or three days, pour it into a clean phial, and you will have a fine varnish.

A fine varnish for blue and other colours, which will make them bright like looking-glass.

IF your table is to be of a blue colour, then paint it first over with indigo and white, ground with oil, and a little turpentine; when dry, you may give it another layer, and heighten or deepen it to your liking, and when this is thoroughly dry, then varnish it with the following varnish:

Take clear Cyprian turpentine half an ounce, sandarac one ounce, mastic two ounces; grind the sandarac and mastic very fine; then take oil of spike two ounces, oil of turpentine one ounce, put it into a glass cucurbite, and dissolve it over a gentle heat; add to it the pulverised gum, set the glass or matrafs in a pan with water; and let it boil over a slow fire for an hour and all will be dissolved and united; then let it cool, preserve it in a phial well stopped for use.

When you use it, first wipe your painted table, and clean it from dust, then take some fine and light smalt in a cup, or upon a plate, according to what quantity your piece requires, temper

temper it with the above varnish, and with a large hair brush pencil glaze it as quick as you can all over; let it dry in a clean place that is free from dust, which will be in about three hours time, then glaze it over again; the oftener you repeat it, the brighter will be your table; and if you will have it of an exceeding fine lustre glaze it over 12 or 15 times.

A Chinese varnish for all sorts of colours.

PUT into a matrafs a pint of spirits of wine, one ounce of gum animæ, two ounces of mastic, two ounces of sandarac or juniper gum, powdered finely together in a mortar; then put them together into the matrafs, close it up, and hang it in hot weather in the sun for 24 hours, or so long over a fire, till the gum is dissolved, and the spirits are tintured therewith; then filter it through a clean cloth, and keep it in a phial closed up; you may mix therewith what colour you please: for red use vermillion, for black use lampblack or ivory black, for blue use indigo and white, *Prussian* blue or smalt and white lead, &c.

How to varnish chairs, tables, and other furniture; to imitate tortoise-shell: so as not to be defaced by oil or spirituous liquors.

FIRST lay your work over with a lac varnish, as you have been instructed above; then lay it over again with red lead and yellow pink, well ground and mixed up with the said lac-varnish; you may do it twice or three times over, letting it dry thoroughly every time before you repeat: after which rub it with *Dutch* rushes, such as the joiners and cabinet makers use.

Then take dragons blood which is a red gum, and may be had at any druggist's beat it very fine in a mortar and temper it with this varnish: if you would be very nice, strain it thro' a fine hair cloth, and put it up in a phial for use; the longer it stands the finer the colour will be; with this you may shade over your table or other work in the best manner you can: if you over-cloud it again, you must have a darker shade: and to deepen your shades, you may add to your varnish a little ivory black, umber or indigo, and work the colours together ac-

cording to the best of your judgment. When you have done your work, and it is thoroughly dry, then take some pumice stone; make it red hot, and beat it to a fine powder, and with this and *Dutch* rushes, soaked in water, rub it smooth, and afterwards with a clean woollen rag; and holding it over a gentle heat, give it five or six more coats of varnish, but be careful it be not heated too much, lest it should blister, and spoil your work; after it is thoroughly dry, then take tin-ashes and sweet oil, and with the rough side of *Spanish* leather polish it, and give it the finishing stroke with some tin-ashes and the palm of your hand, wiping it till it has gained a fine lustre.

From this direction the artist will make further improvements.

A. very fine indian varnish.

TAKE four or five quarts of good spirits, distil and rectify it to the highest degree, that when you light a spoonful it will consume in flames, and leave nothing behind. Having this ready, take gum-lacca, beat it fine and put it to the spirit into a phial or matrafs; let the spirit be four fingers high above the gum, close the glass, by tying a trebble bladder over it, then put it on a hot sand, and let it stand till the spirit and gum is well united and boiled; but be careful to see whether you perceive any bubbles rise to the top of the glass, and as soon as you perceive them, take a needle and prick the bladder, in order to give it vent, else your glass will be in danger of bursting.

After which, filter it through a filtering paper into another glass, and keep it close stopped for use.

If you would use this varnish with colours, let them be first ground with rectified spirits, and then temper as much as you have occasion for present use with the varnish, and lay it on your work; and when you think you have laid your varnish thick enough, polish it, when dry, with *Dutch* rushes; then give it a second polish with tripoli and sweet oil; afterwards give it another layer or two of clear varnish, and it will be fine, and answer the purpose.

To

To japan with gold, glass, or any other metallic spangles.

FIRST lay on your work with lac-varnish; then grind Cologne earth and gamboge with the same; this varnish must be bright and clear; with that colour lay your work once or twice over: let it dry, and then varnish it over, and sift on the gold dust, or whatever else you design it for. If your work or table is large, lay the varnish on one place after another; for the varnish will dry in one part before you have done sifting the other. After you have sifted your work all over, and it is thoroughly dry, then give it twelve or fifteen lays more of clear varnish, after which smooth and polish it as directed.

A very fine varnish for a violin.

TO do this in the best manner, you must have three glasses before you: in the first put of the finest gum lacca eight ounces, sandarac three or four ounces, both very finely pulverised; upon this pour of the best rectified spirit of wine, so much 'till it stands four inches above the ingredients: when dissolved strain it through a cloth, and place it closed up in a still place to settle; in a few days the top will be clear, which you are to decant off in another glass, and preserve it from dust.

In the second glass put of dragon's blood five ounces, and of red wood three ounces, make a solution and extract of them with the same spirit of wine.

In the third glass dissolve of *colophony* three ounce, *aloes succotrines* two ounces, *orlenium* three ounces; and when the whole is extracted, then pour the ingredients of the three glasses into one, stop them up, and let them settle; then pour off what is clear at top, and filter the rest through a brown paper. If you find the varnish too thin, exhale it a little over a gentle heat, and you will have a fine red varnish, which will gild pewter, and be of an excellent composition for varnishing of violins, &c.

A choice varnish which cannot be hurt by wet.

TAKE gum copel, as much as you please, beat it fine, put it into a glass, and pour off high rectified spirit of wine over it four inches high; then close the glass with a bladder,

N 4

set

set it for twenty four hours in a warm oven for the gum to dissolve, after which put the glass in *baln. mar.* 'till the spirits and the gum are incorporated.

A good varnish for paintings.

BEAT the white of an egg, after you have dissolved a piece of white sugar-candy, about the bigness of a filbert, and half a tea-spoonful of brandy, till it becomes a froth; then let it settle for a little while, and with the clear liquid varnish over your picture; it is better than any other varnish, since it may be easily washed off again when the picture wants cleaning, and be done afresh.

A fine marbling on wood, or japanning.

TAKE of the best transparent yellow amber what quantity you please, beat it to a powder, put it into a clean crucible which is glazed within, let it melt over a gentle charcoal fire, and stir it well, to keep it from burning; then pour it upon a smooth clean marble table, let it cool, and beat it again to powder. Take afterwards clean turpentine, and in a glass warm it in a sand heat, put into it the beaten amber, let them boil and dissolve gently together, 'till they are of a consistence fit to be used with a pencil, strain them through a cloth, and you will have the finest lac varnish possible; and although it be of a brownish colour, yet when laid on, it has a fine clear gloss.

The colours wherewith you are to marble, are the following; lampblack, brown-red, ocher, vermillion; these four are ground with linseed oil; *Venice* white lead is ground with oil of almonds.

For a white, lay your first ground with linseed oil, and if there are any holes in the wood, fill them up with chalk tempered with size. For a black ground lay it first with lampblack and size; when the ground is dry, mix the vermillion with the above described lac varnish, and with a brush pencil lay it on with an even and quick hand; repeat this three or four times till it is bright and fine, and lay the varnish by itself over it twice or thrice; then mix your other colours with the varnish in an oyster-shell, or in little cups, and with them
marble

marble upon the ground you have prepared, in imitation of any thing you design.

A fine gold varnish, wherewith you may gild silvered or tinned things with such lustre as if done with gold.

TAKE of the finest gum lacca, in grains, eight ounces, clear gum sandarac two ounces, dragon's blood one ounce and a half, colophoni, or black rosin, one ounce and a half; beat all together into powder, and put it into a quart of high rectified spirit of wine, which is strong enough to fire gun-powder; put it into a sand heat over a small coal fire, let it boil for two hours (if you do it in *baln. mar.* it is better) or so long until it is dissolved as much as possible; then let it cool; strain it through a cloth into a glass, so as to separate the dross that might have been in the ingredients: this you are to lay on every thing that has been silvered or tinned, three or four times, and it will resemble the brightest gold. If you would have the gold colour still higher, you only add about two grains of gurgummi, two grains of the best hepatic aloes, and one grain of the finest dragon's blood, boiling them up, and straining them through a cloth into another glass.

When you would use it, put the glass into a basin with water over a gentle charcoal fire, in order to make the varnish fluid; it is also requisite to warm the work before you begin to varnish it.

Of CORAL WORK.

To make red coral branches, for the embellishment of grottos.

TAKE clear rosin, dissolve it in a brass pan; to one ounce thereof add two drams of the finest vermillion; when you have stirred them well together, and have chose your twigs and branches, peeled and dried, take a pencil and paint these twigs all over, whilst the composition is warm, and shape them in imitation of natural coral of a black thorn; when done, hold it over a gentle coal fire; turn the branch with your hand about, and it will make it all over smooth and even, as if polished,

In

In the same manner you may, with white lead, prepare white; and with lampblack, black coral.

A gentleman may, with a very little expence, build a grotto of glass cinders, which may be easily had, pebbles or pieces of large flint, and embellish it with such counterfeit coral, pieces of looking-glasses, oyster, mussel, and snail shells, moss, pieces of chalk, oar, &c. As to the cement to bind and cement them together, you have directions how to prepare it under the article of cements.

PART VI.

The Art of preparing Colours for PAINTERS, LIMNERS, &c.

I. OF BLUE COLOURS.

To make, or prepare, ultramarine.

TAKE of lazur stone, or *lapis lazuli*, the blue veins, calcine them in a crucible on a charcoal fire, and quench them in vinegar, repeat this twice over, then grind them on a fine hard stone to an impalpable powder. When thus ground, take white rosin, pitch, new wax, mastick and turpentine, of each six ounces; frankincence and linseed oil, of each two ounces; let them dissolve together over a gentle fire; stir them well with a wooden spatula, in order to unite them together; then pour them into clean water, continually stirring them; take them out, and preserve them from dust for use.

When you design to prepare your ultramarine, take to each pound of the pulverised *lapis lazuli* 20 ounces of the mass. The mass you are to dissolve before a gentle heat, by degrees, in a pipkin, and fling the powder into it by little and little, whilst

whilst it is dissolving; after your powder is all in, and well incorporated with the mass, then pour it into a pan with cold water, form it into little tents or drops; but to prevent its sticking to your fingers, you must anoint them with linseed oil; those tents or drops you are to put again into fresh cold water for fifteen days, shifting the water every other day.

Then take and put them into a clean earthen well glazed cup or basin, and pour warm water on them; when that is cold, pour it off, and put fresh warm water to it; this you are to repeat until the tents or drops begin to dissolve, which will then turn the water into a blue colour.

When the water is of a fine blue tincture, and cold, then decant that into another clean earthen cup or basin, and pour more warm water upon the remaining tents; when that also is coloured, decant it off and pour fresh on, repeating this until the water receives no more tincture.

Let the tintured waters stand for 24 hours to settle, after which you will observe a greasiness on the surface; which, together with the water, you are to pour off gently, and put fresh clean water upon the sediment, stirring it well together, and straining it through a fine hair sieve into a clean bowl; the sieve will attract some of the slimy or greasy matter that might otherwise remain therein; and after you have washed your sieve, and repeated the same thing with the next sediment, straining it through with clear water, three times successively, then let it settle; pour off the water and let it dry of itself. Thus you will have a fine ultramarine.

To prepare a curious blue colour, little inferior to the ultramarine, from blue smalt.

GRIND your smalt very fine, and proceed in every respect as you have been taught above, in preparing ultramarine.

To prepare a curious blue colour from silver.

Hammer silver thin, Neal it thoroughly, and quicken or anoint it a little over with quicksilver; then put a little of the sharpest distilled vinegar, in which you have dissolved some sal-armoniac, into a glass; hang the silver slips over it, so

so as not to touch the vinegar: cover it very close, and put it into a warm place, so that hereby the fumes of the vinegar may be raised a little, these extract out of the silver a very beautiful ultramarine, which adheres to the silver slips; wipe them off into a shell, and hang the silver slips over the vinegar again, well closed; repeat this until all the tincture is extracted from the silver.

Another method.

TAKE of the finest silver what quantity you please, and dissolve it in a clear and strong spirit of nitre; then draw off half of the spirit of nitre, and set the glass in a damp and cool place, and the silver will over night shoot into fine crystals, not unlike saltpetre; then decant the spirit of nitre clear from it, put the crystals into glass plates, and let them stand in a warm place until they run into a flour; then grind them with as much clear sal-armoniac, sublimed over common salt; set them together in the open air, until you see the mass become of a blue or greenish hue; then put them together into a cucurbit with a large head to it, and sublime them, and the sal-armoniac will carry the *anim. lun.* up along with it; after this grind the silver that is left at the bottom of the matras with fresh sal-armoniac, and sublime it as before; this repeat until all the *animæ*, or the fine blue tincture, is extracted from the silver; evaporate the water over a gentle fire, and you will recover your sal-armoniac again; the tincture you are to dry and preserve. It is a fine and beautiful colour, fit to be used for the most curious painting or limning.

Another method.

TAKE of the finest silver as much as you will, beat it very thin, and with four times as much quicksilver make it into an amalgama, strain it through a leather, and drive all the mercury afterwards from it; thus you will have a fine silver calx, which dissolve in clear aqua fortis, the quantity whereof must be as little as possible; when it is dissolved, let the water evaporate, and the silver will remain at the bottom like moist ashes; pour over it some sal-armoniac mixed with sharp white-wine vinegar, let it settle and turn clear; then pour off the vinegar, and keep the sediment at the bottom for a month, well closed up, to prevent the least evaporation, and you will find a very curious blue colour.

To

To prepare a blue colour from verdegrease.

TAKE sal-armoniac and verdegrease, of each six ounces; mix them well together with water of tartar, into a paste, put this into a phial, and stop it close; let it stand for several days, and you will have a fine blue colour.

Another method.

TAKE sal-armoniac one part, verdegrease two parts, beat them both to a powder, and mix them with a little white lead; then incorporate them together with oil of tartar, put them into a glass and close it well; put it afterwards in a loaf, and bake it in a baker's oven; as soon as the loaf is baked enough, your colour will be ready. *Or,*

TAKE quicksilver two parts, sulphur three parts, sal-armoniac four parts; mix and beat all well together, temper them with water, put them in a well glazed pipkin into a furnace, over a coal fire, and when you see a blue smoke arise, take it off and let it cool, then break the utensil, and you will find a fine sky-blue, not unlike ultramarine.

To prepare blue tornisel, a beautiful colour.

TAKE floes, before they are full ripe, beat them into a paste, and put it in a clean earthen pan: take another earthen pan, put into it a quart of water, 3 oz. of quick-lime and $\frac{1}{4}$ oz. of verdegrease, and one quintal of sal-armoniac; let these things soak so long in the water until it is tinged of a green colour. In 24 hours the lime and verdegrease will be sunk to the bottom, then discard off the water through a cloth into another earthen vessel, add to it the paste of floes, and let it gently boil over a slow fire; when cold, it will be of a fine sky blue; then pour that liquid into a clean pan through a cloth, set it on ashes, and when it begins to be of a thickish substance, then put it up in a bladder, and hang it up to dry. You may also dip clean soft linen rags into it, dry them in the shady air; and when dry, repeat it again for 3 or 4 times; these preserve in paper, and when you have occasion to

to use it, soak one of these rags in a little fair water, and you will have a beautiful blue colour.

A blue of egg-shells.

TAKE egg-shells, calcine them in a crucible, beat them to a fine powder; put that into a copper box, and pour vinegar over it; which set into horse-dung for a month, and you will have a delightful blue.

To make Venice sky-blue.

TAKE quick-lime one pound, mix and work it with sharp white wine vinegar into a dough; let it stand for half an hour, and when hard, pour more vinegar to it, in order to make it soft; when done, add to it two ounces of pulverised fine indigo, mix it first well together, set it into a glass vessel for 20 days under horse-dung, after which time see whether it is of a fine colour; if not, set it again, as long as before, in the dung, and it will then come to its perfection.

II. Of several RED COLOURS.

To make fine lac from cochineal.

TAKE cochineal eight ounces, allum one pound, fine and clean wool eight pounds, fine powdered tartar half a pound, bran of rye eight handfuls; boil the bran in about three gallons of water, more or less, it is no great matter; put it over night to settle, and pour it through a flannel to have it clear and fine; then take a copper kettle, large enough to contain the wool; pour half of the bran water and half clean water to it, so much as you think sufficient to boil the wool in; let it boil, then add the above tartar and allum to it, and put in the wool, let it also boil for two hours, turning all the while the wool up and down, in order to cleanse it thoroughly; after it has boiled that time, put the wool into a net, to drain out the water: take then the other half of the bran water, and add to it as much clean water, and let it boil; after it is well boiled up in cochineal, which must be previously ground very fine

fine with four ounces of white tartar; you must stir it continually about, whilst it is boiling, to prevent its running over, then put in the wool, and let it boil for an hour and an half, keeping it all the while turning about; after the wool has attracted the colour, put it again into a net, let the water drain off, and you will have it of a scarlet colour.

This colour may indeed be done in another manner, and of a brighter lustre, in a pewter kettle, with tin and aqua-fortis, but the above method is sufficient for the purpose designed, and may be made by any body, without the implements which are required to dye it the other way.

To extract the lac from the scarlet wool.

TAKE clean water about six or seven gallons, dissolve therein as much pot ashes as will make it a good sharp lee, filtrate it through a felt or flannel bag to make it very clear; in this put the wool, let it boil well in a kettle, till it is white again, and the lee has extracted all the colour; then pour it again through a clean felt or rag, and squeeze out the wool; then take two pounds of allum, let it dissolve in water and pour it in the coloured lee; stir it well together, and it will curdle and turn of a thick consistence like a paste; pour it again into a clean bag, and the lac will remain in the bag, but the lee will run clear from it; and in case it should still run coloured from it, you must let it boil with a little of the dissolved allum, which will wholly curdle it, and keep the lac black.

When the lac is in this manner in the bag, pour clear water over it, in order to clear it from the allum or salt that may still remain in it, and take a plate of plaister of Paris, or chalk, strain the lac through a paper cone that has a small opening at the point, in little drops or tents upon it, and when dry, put them up for use.

You must observe, that in case the liquor should fall short in boiling the wool, you must recruit, not with cold, but with warm water.

If you can get the parings of scarlet cloth, you will save yourself much trouble, by only boiling them in the lee, and proceeding as has been directed. Or,

TAKE

TAKE lee of ashes or tartar, to this put a little dissolved allum, and pour it into a wide glass vessel; then take cochineal, put it into a close linen bag, and swing it backwards and forwards in the lee, till all the colour is extracted; then take lukewarm allum water, pour as much upon the lee as will curdle it; pour the curdled lee through a flannel, sweeten it with clear water, then dry the colour on a piece of plaister of Paris, as before directed.

To make fine vermillion.

TAKE two parts of quicksilver, and one third of sulphur, put it into a pipkin, and melt the sulphur and the quicksilver together; when it is cold, then grind it well upon a stone, and put it into a glass, which before-hand has been laid over with a coat an inch thick; then make a coffin of clay for the glass to stand in, set this on a trivet, first over a slow fire; put a cover of tin, with a little hole in the middle upon the glass, and lute it all round: put an iron wire through the hole, for to stir it about, augment your fire by degrees, and watch your glass carefully; for you will see a coloured smoak proceed from the matter in the glass, but keep on augmenting your fire, till you see the smoak become of a red crimson colour, then it is enough; take it off the fire, let it cool, and you will have a fine vermillion.

Before you use it to paint or write therewith, take as much vermillion as you will, and grind it well with good white-wine on a stone, and after that with the white of eggs, add a little hepatic aloes to it; make it up in little cakes, and when dry, put them by for use. When you use them, grind or dilute them with clear pump water, and a little white of eggs; and if it will not flow readily from the pen, mix a little myrrh with it.

How to purify vermillion.

THE vermillion being made of mercury and sulphur, the impurities which it has contracted from those minerals must be separated, and this is done in the following manner:

Grind the pieces of vermillion with water upon a stone, and put them on glazed plates to dry; then pour urine upon them,
and

and mix them thoroughly with it; so that it may swim over it; let it thus stand, and when the vermillion is settled, pour off that urine, and put fresh upon it; let it stand all night, repeat this four or five days successively, till the vermillion is well cleansed; then pour the white of eggs over it, mix it up therewith, and stir it well together with a spatula of hazel, let it stand again, when settled pour it off, and put fresh on; repeat this three or four times, covering your vessel every time close, to keep the dust from falling into it, which else would diminish the beauty of the colour: when you would use this vermillion, dilute it with gum-water. *Or,*

GRIND the vermillion with the urine of a child, or spirits of wine, and set it to dry in the sun.

If you would have the vermillion of a high colour and free from its black hue, then put into the spirits or urine a little saffron, and grind your vermillion with it.

To make a fine purple colour.

MELT one pound of tin, after which put two ounces of quicksilver to it; stir it so long together, till it is an amalgama; then take sulphur and sal-armoniac, of each one pound, grind it fine, and mix it up with the amalgama, in a stone mortar or wooden bowl; put it into a glass, which is well coated with clay, set it first over a gentle fire, and augment it by degrees, so as to keep it in one uniform motion; stir the matter with a stick, and when you perceive it to be of a yellow colour, take it off the fire, and let it cool, and you will have a fine gold colour, besides a beautiful purple.

III. Of all Sorts of COLOURS extracted from Flowers, &c.

How to extract a yellow, blue, violet, and other colours.

PREPARE a middling sharp lee from lime, or pot-ashes; in this boil the flowers or leaves of single colours, over a slow fire, so long till the tincture of the flowers is quite extracted, which you may know when the
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leaves

leaves turn pale, and the lee is of a fine colour. This lee put afterwards into a glazed pipkin or pan, and boil it a little, putting in some roach allum; then pour the lees off into a pan with clean water, and you will see the colour precipitate to the bottom; let it settle well, then pour that water off, and add fresh; repeat this till the tincture is entirely cleansed from the lee and allum; and the freer it is therefrom, the finer will be your colour. The sediment is a fine lake, which spread upon linen cloth, and lay them on clean tiles in the shade to dry.

You may dry your colours upon a plate of plaister of Paris, or for want of that, on a piece of chalk; either of them will do, and dry the colours quicker than the method above.

To the receipt for extracting the tinctures from flowers, leaves, herbs, and plants, by distillation, which has been already inserted p. 151. I only add, that it will be adviseable to preserve the first droppings of the extraction that fall in the receiver, by themselves, they yielding the finest and most beautiful colour. Care must also be taken, not to bruise the tender leaves of the flowers, else the coarse juice will distil along with the tincture, and make it of an unpleasant hue. Such leaves that are firm and strong, require not that care.

Mr. Kunkel's *method of extracting the colours from flowers, &c.*

I Take, says he, high rectified spirits of wine, and pour it over a herb or flower, which I will; and if the leaves of plants are large and coarse, I cut them small, but I leave the leaves of flowers whole, as soon as I perceiveth the spirits tinctured, and find both colours of an equal tint, I put them together; but if they differ, I set each apart by itself, after which I distil the spirits of wine from it to a very little, so that I may take it off the cucurbit, and then put it into a china tea saucer, a glass cup, or a small matrafs, and let it evaporate over a slow fire till it comes to some thickness, or, if you will, quite dry; but this must be done very slowly, on account of the tenderness of the colour.

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Some flowers will change their colours and produce quite different ones, and this the blue flowers are most subject to; to prevent which, one must be very slow and careful in distilling them; I have never had so much trouble with any other coloured flowers as the blue ones, and yet, I cannot boast that I have obtained a blue colour from flowers to my satisfaction. The whole matter depends chiefly upon care; practice will be the best instructor.

By this method one may plainly see what flowers or plants are fit for use, for by only infusing some in a little spirits of wine, it will soon shew what colours they will produce.

IV. Of GREEN COLOURS.

How to make good verdegreafe.

TAKE sharp vinegar, as much as you will, clean copper flakes one pound, salt three quarters of a pound, red tartar eight ounces, sal-armoniac two ounces, leaven twelve ounces; beat what is to be beaten to a fine powder, and mix the whole with vinegar well together; put it into a new well glazed pan, cover it with a lid, and lute it with clay; then bury it for 18 or 20 days in horse dung. Take it out again, pour off the vinegar gently, and you will have good verdegreafe.

Another.

TAKE a well glazed pan or pot, put into it good sharp vinegar, then take thin copper filings a pretty large quantity, put them into a crucible, and set the same into the pan with vinegar, so that the vinegar may not touch the copper; then lute the cover well with clay to keep out the air; thus put the pan into horse dung, or into a warm place, for 25 days; then take it out again, open it, and you will find the verdegreafe hang to the copper filings, scrape the verdegreafe with a knife off the said filings, and let it fall into the vinegar, after which, close up the pan again as you did before, put it into the dung or a warm place, and thus repeat it till the cop-

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per is all consumed: the verdegreafe will settle at the bottom of the pan, which, after you have gently poured off the vinegar from it, you may put up for use.

Another easier method to make verdegreafe.

TAKE a copper kettle or bowl, put into it good sharp vinegar; set it in the heat of the sun to dry, and you will have fine verdegreafe; after you have taken it out of the kettle or bowl, you may pour more vinegar, and repeat it as often as you think proper.

To make a fine verdegreafe for dyers.

FIRST take four pound of tartar, two pound of salt, one pound of copper-ashes, one pound and a half of good vinegar, then take a crucible or an unglazed pan, take a handful of tartar, and fling it into the crucible, also one handful of salt, and a handful of copper ashes, fling in all, one after another, till the crucible or pan is full; then pour on the vinegar, and stir it well together, till the ingredients are thoroughly moist, and are turned of a black colour, cover the pan and lute it close with clay, to prevent the air coming to it, put it for a fortnight or three weeks in hot horse dung, and you will have a good verdegreafe. If you would have it dry, hang it up in a bladder in the air. Or,

TAKE vinegar in which has been steeped some copper, and one pound of searfed salt; mix the salt with so much vinegar as to make it of a consistence; then put it into a copper vessel, close it up and set it in a damp place; and after it has stood some days, you will have a good verdegreafe. Or,

TAKE an old kettle or copper, and scower it clean with sand; then take vinegar and honey, of each an equal quantity, mix them together, and strike the mixture all over the inside of the kettle; then take searfed salt, and sprinkle it upon the honey, so as to stick to it; have a board, made with a good many holes, and cover the kettle therewith; then
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turn your kettle with the board upon hot horse dung; cover it all over with dung, and let it stand for eight days together, and you will have a fine verdegrease.

A fine verdegrease for limners.

TAKE copper-slips or filings, put them into a strong copper-box, with a cover to it; pour some vinegar mixed up with a little honey, into it; set it in the sun, or in a warm place for fourteen days, and the vinegar will become blue; which pour into a glass, and close it well up: then put more vinegar and honey upon the copper-filings, and proceed as before, till they do not tincture the vinegar: what you have gathered up in glasses, put it in the sun or a warm place, till it becomes of a proper thickness; then grind it on a stone, and temper it with a little gum-water: if you would have it of a grass green, mix it with a little sap-green.

How to make sap-green.

ABOUT a fortnight or three weeks before *Michaelmas*, take as many flos as you please, mash them a little, and put them into a clean glazed pan; sprinkle them well over with powdered allum, and let them stand in a hot place for 24 hours; and then pour upon them a clear lee, put it upon a fire, and give it a slow boiling, till a good quantity is boiled away; then take it off the fire, let it cool, and pour it through a cloth; what comes through, put up in a bladder, and hang it in the air to dry; afterwards keep it always hanging in a dry place or in the chimney corner; and when you have occasion to use it, take as much as you want and dilute it with clear water: if it should turn too much upon the yellow, mix it with a little indigo.

Another finer sap-green.

TAKE of blue lillies that part of the leaf which is of a fine blue colour, for the rest is of no use, and stamp them well in a stone mortar; then put upon them a spoonful, or according to the quantity of the leaves, two or more spoonfuls of water, wherein before has been dissolved a little allum and

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gum

gum arabick, and work it well together in the mortar; then strain it through a cloth, put it into mussel shells, and set them in the sun to dry. *Or,*

AFTER you have proceeded as before, fling some powdered quick-lime over it, before you strain it through a cloth, and put it in mussel shells. *Or,*

BEAT the blue leaves of lillies in a stone mortar, strain them through a fine cloth into mussel shells, and fling some powdered allum over it, to one more than the other, in order to make the colour of different shades.

To prepare a fine green colour.

TEMPER indigo and yellow orpiment with gum-water: grind it fine, and mix with it a little of ox or fish-gall, and you will have a pleasant green. You may shade it with indigo or sap green, and heighten it with *Dutch pink*.

OF WHITE COLOURS.

To make fine white lead.

TAKE some cast sheet lead, cut it into plates of about two inches wide, and six or eight inches long, make through each of them a hole, to draw a string through; then have an oaken vessel, about two foot high, into this put two quarts of good vinegar, and a vessel, and cover it; set it over a gentle coal fire, and let it be boiling hot; then take it off, and put it for ten days in a warm place; then take off the cover, take out the plates, and they will be covered with a white colour on both sides, a finger thick, which your are to scrape off with a knife, and put into a clean basin; then hang the plates again in the wooden vessel, and proceed as before, scraping.

scraping the colour once every ten days : grind the colour in a stone mortar with clean water to a paste, and put it up in clear pans to dry.

Another method to make white lead.

TAKE long and flat pieces of lead, hang them in a glazed pan, or rather in an earthen square vessel, pitched on the inside, but before you hang the lead in the vessel pour into it good vinegar, heated ; cover it close, lute it to keep out the air, and put it in a warm place for a month or five weeks ; then take off the cover, and scrape off the white lead, which hangs about the lead, this you may repeat every fortnight or three weeks, and you will have good white lead.

To prepare another white colour.

TAKE quick-lime, mix with it calcined egg-shells ; grind these two ingredients with goat's milk very fine, and it is fit to paint withal.

A good white colour.

TAKE crown glass, and beat it to an impalpable powder ; take also fine pulverised sulphur, mix them together in a pan with a cover to it, lute it close, and put it upon a charcoal fire, so as to make the pan red hot all over : when it is thus heated, take it off the fire, and let it cool ; then take off the cover, grind the matter upon a stone with clear water, and temper it either with oil or gum water : it will give a good white colour.

A fine white colour for painting in miniature.

TAKE four ounces of good bismuth, beat it fine ; then dilute it in eight ounces of the best clarified aqua-fortis, pour the solution into a glass, and put a little salt water to it, and the bismuth will precipitate to the bottom, in a snow white powder ; pour off the water, sweeten the powder well with clean water from the sharpness of the aqua-fortis ; then dry it and keep it carefully from dust ; when you use it, dilute it with gum-water.

How to refine white lead.

TAKE fine white lead, grind it upon a stone with white-wine-vinegar, and it will turn black; then take an earthen dish full of water, wash your ground white lead well, and let it settle; then drain the water gently from it, grind it once more upon a stone with vinegar, and wash it again: repeat this three or four times, and you will have a curious fine white, that is fit for the nicest work, both in oil and water colours.

How to prepare egg shells, for white.

SOAK the egg-shells three or four days in good sharp vinegar; then wash them in clear water, dry them in the heat of the sun; beat them to a fine powder, and grind them on a stone.

Of several BLACK COLOURS.

To burn lamp-black, in order to make it finer, and of a better colour.

TAKE a fire shovel, hold it so long in the fire till it is red hot; then fling your lamp-black upon it, and when it is done smoaking, it is enough.

How to make a finer lamp-black than what is ordinarily sold in colour or chandlers shops.

HAVE a lamp with a large wick of cotton stored plentifully with oil; fix over the lamp a sort of canopy, made of tin or iron; the smoak which settles to it, sweep off with a feather, and preserve it from dust. When you use it, temper it with oil or gum-water.

To

To make a black of trotter-bones.

TAKE as many trotter-bones as you please, burn them in a clean crucible, and quench them in damp linen rags; grind them with fair water, before you use them with it: this black is fit to be mixed with lake and umber for shades, in carnation or flesh colour.

To make ivory black.

TAKE the shavings or raspings of ivory, which you may easily have at the comb-makers: mix them up with a little linseed oil, put them into a pan or crucible, and lute it close, leaving only a little hole in the middle of the cover; set it on a coal fire, and let it stand till you perceive no more smoak; then take it off, and set it in sand, putting another pan or crucible that is entire over it; when cold, you will have the finest black colour that can be prepared.

Another method to burn ivory either black or white.

FILL a crucible with the wastes of ivory or hartshorn, lute it well, and put it in a fire, and when the phlegm, spirit, oil, and fluid salts have left them, they will be of a very fine black colour; but if you keep them longer in the fire, they will turn as white as snow.

A cherry-stone black.

FILL a crucible with cherry-stones, cover and lute it well; let them dry first by degrees, then burn them to a coal; afterwards beat them to powder, and moisten them with gum-tragant water; form them into little balls, and they are ready to be used, either for oil or water colours.

To make Indian ink.

TAKE dried black horse beans, burn them to a powder, mix them up with gum arabic water, and bring them to a mass, which press in a mould made for that purpose, and let it dry. Or,

TAKE

TAKE one ounce of lamp-black, two ounces of indigo, half an ounce of fish black, grind them with half water and half milk, and a little gum arabic, and form tables thereof. The lamp-black must be cleared from all greasiness, by burning it in a clean pan, on a coal fire.

To make a fine ink-powder to write or draw with.

TAKE half an ounce of lamp-black, plumb or cherry-stones, vitriol and gall-nuts of each half an ounce; burn it first together in a crucible; add half an ounce of gum-arabick: all which beat in a mortar to a fine powder, and searse it through a fine searfer, then put it up in a box, and when you want to use it, dilute it with fair water.

To prepare dry colours or crayons.

FOR *crayons* you make use chiefly of earth or mineral-colours, which you grind with milk into a paste, and then form it into pastils of what size you please, and let them dry in the shade.

Some break the colours with incorporating them with plaister of Paris, with which they bring them to the several lights or shades they require.

Others instead of plaister of Paris use tobacco-pipe-clay, and when dried, the artist makes use of blue paper pasted on a linen cloth that's stretched in a frame, and works them one in another with a blunt pencil brush, or a rolled-up blue paper.

Several Methods of GILDING.

A particular way of gilding for such painters or gilders as are obliged to perform in the open air, where the leaf gold cannot be managed, on account of the wind.

TAKE thin pewter leaves, strike them over with a gold ground, or gold size, and when you are obliged to gild any thing that is high, and you have no shelter to keep off the wind,

wind, lay only size on your work something stronger, in order to make the pewter gilded leaves stick on the better.

How to gild upon wood, picture frames, or any other sort of work.

THE wood must be first well smoothed, then twice or thrice struck over with size made of the shreds of glove leather, and ground nine or ten times over with chalk; when it is dry, rub it well over with *Dutch* rushes, to make it even and smooth, then with a soft hair pencil lay it over with size water; after which lay on the gold coloured ground, twice or three times; when it is thorough dry, rub it over with a linen rag, till it looks polished: then have your leaf gold ready cut upon a leather cushion, and when with a large pencil, dipped in the strongest brandy you can get, you have gone over your work, be nimble in laying on the gold: when it is quite dry polish it with a tooth.

How to prepare the size for the use just now mentioned.

TAKE two pounds of cuttings or shreds of white glove leather, let them soak for some time in fair water, and then boil them in a pot with ten quarts of water, let them boil to two or three quarts, then strain them through a cloth into a clean earthen pan: you may try whether the size be strong enough, by taking a little between your fingers, to see whether it is of a glueish consistence, and whether it will stick.

To prepare the white chalk.

WHEN you have made the size, then take white chalk, scrape it fine with a knife, or grind it upon a stone; and when you have dissolved your size over the fire, and it is made hot, put in so much chalk as will make it of the consistence of a thick paste; keeping it standing for a quarter of an hour, and then stir it well about with a hard brush pencil: add to this white colour some more size, and after you have mixed it well and brought it to proper temper, lay it on the wood which you design to gild, by laying it all over with a broad pencil, and when you have done, let it dry thoroughly, before you

you lay on another ground. This you must repeat ten or twelve times.

When you have done laying on your gold ground, then with a soft broad hair pencil, moistened with clear water, run it all over, in order to smooth your ground, and when dry, rub it over with *Dutch* rushes, or a piece of new linen, smooth and fine.

How to bronze or metallise images of plaister of Paris.

TAKE isinglass, steep it in very strong brandy, put it well closed in a warm place, and it will dissolve; add to it a little saffron, and mix it up with metallic powder in a mussel or oyster shell, this strike over your image with a soft hair pencil; but before you do this, you must wash it over with size water, mixed with a little red lead.

How to prepare the Norimberg metallic powder of mixed colours, which gives a beautiful lustre when strewed upon writing or letters.

TAKE the filings of copper, brass, iron, steel, or any other metal, searse them through a fine sieve, and put them into a clean bason or such like vessel, wash them well with a clean and sharp lee, and when you have poured that off wash them with clean water, so long till you have cleansed it from all its soil.

After your filings are thus cleansed and dry, then take a smooth plate, either of iron or copper, lay it upon live coals, and put one sort of the filings upon the plate, stirring it continually about with an iron spatula: as soon as the metal is touched with the heat, it changes into variety of colours, and that which suffers the greatest heat will contract the darkest colour, each metal of a different sort.

When thus you have done one sort, proceed in the same manner with another, by which means you will have variety of colours.

Then take a platting mill, such as the silver wire drawers use, or those employed in platting of gold, silver or copper plate, which must be fitted with a sort of funnel at top, through which the filings may be conveyed to the platting rolls, which ought to be very exact and parallel to each other, made of the
finest

finest steel, and polished like a looking-glass. When you are thus prepared, work it with carefulness between the rolls, and you will have a most beautiful powder, which sparkles with all manner of colours.

The filings of brass produce a bright gold colour; the copper a fine red fire colour; iron and steel all manner of shades of blue; pewter, marcasite, and bismuth, produce a white colour.

To spot a white horse with black spots.

TAKE litharge three ounces, quicklime six ounces; beat them fine and mix them together; put the mixture into a pan, and pour a sharp lee over it; then boil it, and you will have a fat substance swim at top, with which anoint the horse in such places as you design to have black, and it will turn of that colour immediately.

It has the same effect in changing hair that's red into a black colour, with only this difference, *viz.* You are to take an equal quantity of lime and litharge, and instead of boiling it with lee boil it only with fresh water; what swims at top, is fit for use, and will answer your expectation; what hairs you anoint with it in the evening, will be black the next morning.

How to dapple a horse.

TAKE in the spring the large buds of young oak-trees, mix them among the horse's provender, and give it him three or four times to eat, and he will be dappled, and continue so for a whole year; the buds of young elm-trees will have the same effect.

PART

P A R T VII.

Of the Nature and Growth of SALTPETRE.

THE earth being naturally inclined for the generation of saltpetre, there is no occasion to ascribe the growth thereof to the urine and excrements of certain animals; for this may be plainly seen in some particular vegetables, as wormwood, &c. which although it grows in such places, where there has been no such excrement or urine, when the juice thereof is pressed out, will of itself shoot into saltpetre, as is often experienced by apothecaries and chymists. However, it must not be denied, that urine and excrements, particularly that of sheep, contribute not a little to the growth thereof.

Saltpetre is of such an increasing nature, that whatever place is once impregnated therewith, its ferments are multiplied to admiration; and like to a little acid or bitter, will diffuse its qualities among a large quantity: whoever considers this, will easily conjecture how to assist nature in the growth of saltpetre. Even ocular demonstration will prove this; for if one only takes a silver calx, that is taken out of aqua-fortis, and put it into a glazed earthen plate, and therein sweeten it with clear water, one will find that the small quantity of spirit of nitre which remained in the calx, and is drawn from it by washing it in clear water, impregnates the earthen plate in such a manner, that although the most remains in the water, yet it ferments in such a manner, that in a little time, it grows all over and out of the plate, and causes the glazing to scale and fall off.

We know, that when aqua-fortis is distilled from common salt, the dregs thereof will turn into good burning saltpetre; and more so, if for example you dissolve common salt in aqua-fortis or spirit of nitre, warm, and set it afterwards to stand in the cold, it will shoot in saltpetre. From which funda-
mental

mental experiments one might try a fermentation, whereby saltpetre might be in greater quantity generated, as indeed some, not without good success, have made attempts that way, and that in different methods. Some have assisted the saltpetre earth, after it has been boiled out, with trifling means, that in a short time the earth has grown rich therein again, which was, by mixing the earth, when laid up again, with the skimming of what was boiled out.

Others dig one or more large pits in the earth, and with the earth flung up, wall it round for to prevent floods of rain running into it; for which reason they cover it also with a roof, to keep it from rain, but leave it open to receive the sun beams and the air. In such holes they fling all their sweepings, ashes of which lee has been made, as well as others that seem useless, the remains or ashes of burnt straw, foot of chimneys, the sweepings of poultries, pigeon-houses, all sorts of bitter and sharp vegetables, as wormwood, wolfs-milx, nettles, fleegrass, sea-bands, the fallen fruit in autumn, or rotten fruit, the excrements of men and beasts, and any dung, the outcasts or garbage from slaughter-houses, as hair, claws, horns, the paunch with dung, guts and blood, all manner of urine, suds that have been used in washing, and the like, till the pit is full; where let it rot for some years, daily flinging upon it urine, brine of herrings or meat, and such like, till it is rotten; then they cease from flinging any moisture upon it, and let it lie dry till they boil the saltpetre out of it: then they fling what remains again into the pit, pouring upon it the liquor that will not shoot, and so let it lie a considerable time before they boil it again.

Others have built particular long vaults underground, about three yards deep, covered with boards or with a roof of pantiles. The mortar for it is prepared of three parts lime, slackened with rain water, which has fell with a north wind, sheep's urine one part, sheep's dung three parts, all well beat together, and mixed with common salt; with this the vault is built up two bricks thick, then cover it with old stable dung; every fortnight, in the increase of the moon, it is watered all over with north wind rain water, and sheep's urine: and the saltpetre will shoot out in the vault into crystals.

Another method for the speedy growth and increase of saltpetre is, by building a shed of deal boards, as large as you please

please or have conveniency for; but, if possible, in a place where it may lay open to the four winds; the roof is either boarded or thatched, but the four sides are left open: under this shed a layer of earth is laid, about a foot high, in four different heaps; then is poured over a brine of salt lime, mixt with the urine of men and beasts; over this is laid another layer of earth, and proceed as directed before, repeating it till the shed is near full, and working each heap gradually tapering up in the form of a roof, so that the wind may the easier penetrate into each heap; then laying a coat of earth over it, the salt and other liquids are poured over it again: after these four heaps have stood a month, they are, every third or fourth day after the new moon, raked up with an iron rake, about a foot deep, and moistened with urine and saltpetre water, or dung-lee, which is poured upon them out of a watering-pot. After these heaps; thus prepared, have stood about four months, they will be twice as rich in saltpetre, as the common saltpetre earth, and may be boiled out every quarter of a year: the earth when boiled out is laid up again under the shed, and worked up as before; and whilst the last heap is boiling out, the first is in its bloom again, and encreases in richness more and more; so that after a few boilings, it may be boiled out, every month. The conveniency, dispatch and profitableness of this saltpetre work will require to have the boiling house in the middle of the four or more heaps: but then the roof of the shed should not be thatched, for fear of any accident by fire: there may (if the shed be filled with large heaps) four coppers be fixed in the boiling house, and so contrived that one fire may serve them all.

I shall here present the reader with a scheme for a saltpetre garden, which was formed by *Cordil*, and use his own direction, which is thus:

Build a vault about 60 or 80 yards in length, or according to what room you have to spare, four yards high, and eight broad, on a firm ground; let there be two doors, the one towards the north and the other towards the south, and dress the top of this vault like a garden; at one end whereof have a little house for a labourer to live in, who is to look after the saltpetre work, and water the garden every second or third day in the increase of the moon; he must save beforehand the water of a south or north wind rain, which is best, and mix it with

with urine of men, horses, oxen, cows, sheep, &c. flinging into it several handfuls of common salt, and stirring it well together: in the winter season, when there is hard frost and snow, the vault must be sheltered with boards, and a little charcoal fire kept in it, leaving both doors open; but this is only to be observed in very hard winters. When the vault is thus finished and attended, the owner thereof will in six or nine months time find the saltpetre shoot out in great quantities, and the oftener the crystals are broken off, and the garden nourished by watering, the more it will increase in quantity. It is not to be expressed of what benefit such a work is, both for himself and posterity.

The floor and foundation of the vault must be rammed down hard and close; the side walls, half an ell thick, may be built up with pebble, brick, or any other stones; but the arch of the vault must be done with bricks, prepared in this manner: take the earth for bricks, work it up with north or south rain water and urine, of which you must have a sufficient quantity ready beforehand; with this, work and form your bricks, and burn them like other common bricks. For example: take 12 barrels of brick earth, four of lime, two of salt and one of saltpetre; all these are to be well worked together, moulded and burned as usual.

For the mortar wherewith the bricks of the arch of the vault are joined together, you must take four barrels of clay, four of lime, one of salt, one half of saltpetre, and half a barrel of sheeps dung, all well worked together, and moistened with the above rain water and urine, tempered to a proper thickness for mortar. In the middle of the vault, let an opening be made, raised like a funnel, and secured with iron bars at top: after the vault is thus built and enclosed, raise a ground over it about three quarters of a yard high, with common putrified earth; but if it can be mixed with excrements or stable dung, it is the better. This will be sufficient for the ingenious adventurers to improve upon.

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Another

Another method for furthering the growth of saltpetre, is the following :

FIRST erect sheds, each of four posts, nine or ten foot high, of a proportionable thickness, six foot distance from each other, fastened with joists, and thatched at top. When your sheds are ready, lay fat black earth, about a foot high, upon a level; then fling the following mixture, about three inches thick, upon it, which is this : take salt 12 pound, saltpetre four pound, quick-lime 12 pound; this well beaten and worked together, is fit for use.

After you have covered the first layer of earth with this mixture, then rake it well together with the earth, and when done, pour over it dung, lee and urine out of a gardener's watering pot; then rake and wet it again a second time.

After this, proceed thus with another layer of a foot high, so as to go up tapering, one layer after another, till it is about six foot high; then coat it all over with sheeps dung.

You must observe to begin this work with the new moon; and after your heap has stood three or four nights, rake it all afunder, and proceed as you did at first; this you must do in the time of the increase three or four times, and repeat it for three months together: in the decrease of the moon you must let it rest, and after the three months are expired, you will have a very rich saltpetre earth.

Every shed or heap must be at least eight feet distant from one another, for the benefit of the air. After you have brought several of these sheds to perfection, you may boil saltpetre successively; for before you have done with three or four heaps, the first of them will be ready again to boil, and your earth, the more and oftener it is boiled, will grow the richer.

N. B. For watering the earth, you may, if it can be got, use the pickle of herrings, or other salt liquors, soap-lees after cloaths are washed therein, also allum and other liquors that are flung away by dyers: you must also observe, to lay a coat of sheeps dung over your heaps, every time you have raised them.

Glauber, in his book, entitled *The Welfare of Germany*, when he treats of the growth of saltpetre, and the benefit it yields

yields to many poor families, expresses himself in this manner.

‘ In the third chapter of the first part, about concentrating of wood; the pressing of wood to boil saltpetre, is only mentioned; but as wood is not plenty every where, and as it cannot in many places be spared, to cut it down for boiling saltpetre out of it, it may be brought to bear, that a large quantity of saltpetre may be produced out of the faded leaves of trees, as also out of wild grass that grows under trees, so as to have no occasion to cut trees down on that account. And in such places where there is a scarcity of wood, but a plenty of corn, saltpetre may be prepared from straw and stubble; and there is not a place in the world which does not afford matter for the produce of saltpetre. Wherefore I cannot neglect to communicate to all good and pious husbandmen a valuable art, by which they may provide and lay up a hidden treasure, which thieves cannot steal, for their children, and for a relief to themselves in time of distress, thereby reflecting upon God’s providence, and remembering their tutor. For as in the said treatise I have taught three choice secrets, both for rich and poor, great and mean; but they being useless to those who have neither wine, corn, nor wood, I have thought it good, not to be forgetful of those who are destitute of either, and are yet willing to provide for their wives and children, with honesty in the fear of God, to teach them a beneficial art, hoping it will tend to the glory of God, and their own advantage.

‘ First, then a young beginner should have God before his eyes, and admonish his wife and children, if he has any, to fear God, keep his commandments, and love his neighbour. Then shall he determine within himself, to manage his fortune left him by his parents, or which he had with his wife, with such caution, care and frugality, as not to diminish, but to encrease it every year: that when God shall visit him with sickness, or a charge of children, he may have something laid by for a rainy day. Besides this, he ought not to put his hands in his bosom, but turn them early and late to labour, and look for the blessing of God on his endeavours: and to him that has had but a slender fortune from his parents, I give him a lesson, in what manner he may lay up a treasure for his children, without much trouble or pains.

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‘ In the first place, let him build a shed north-east of his
 ‘ house or habitation, if it can be done conveniently, else at
 ‘ any other place, so that the sun and air may come at it, but
 ‘ the rain be kept out, in which shed make a deep pit ; with
 ‘ the earth which is flung up, wall it in to keep out the rain-
 ‘ water : after this he shall begin to gather from day to day,
 ‘ and from year to year the below specified things : so long, and
 ‘ as much, till one time or other, in case of necessity, he is
 ‘ obliged to dig for them, and to see what God has provided
 ‘ for him, and then reap the benefit thereof.

‘ The things he is to fling in, are all sorts of sharp and
 ‘ bitter plants, which grow in uncultivated places, hedges
 ‘ and paths, and are no benefit to cattle, such as are the
 ‘ thistles, wormwood, the large stalks of tobacco, which (if
 ‘ they are planted) are flung away ; also the hard cabbage
 ‘ stalks and leaves, and other things unfit for cattle to feed
 ‘ upon ; pine apples, if they are to be had, and in autumn the
 ‘ leaves of trees ; also pigeon’s and hen’s dung, and the dung
 ‘ of any other creature. If you can have the feathers of
 ‘ poultry and wild birds, fling them in ; fling also in all the
 ‘ ashes whereof lee has been made, and fit for nothing but to
 ‘ be flung away ; also the chimney foot, and from the slaugh-
 ‘ ter-houses the blood, if not used for any thing else ; hog’s
 ‘ hair, horns and hoofs of oxen and cows ; the bones which
 ‘ the dogs cannot gnaw, save them and fling them into the pit ;
 ‘ and not only the outcast and scraps that are made in your
 ‘ own house, but also (to have the pit the sooner full) those of
 ‘ your neighbours, if they have no use for it themselves ; and
 ‘ thus one may in one or two years time fill a large pit with
 ‘ such things : in the mean while the urine in the house must
 ‘ be saved, and flung into that place ; and if you can also
 ‘ have it from your neighbours for that purpose, it is good ; for
 ‘ those things in the pit should be kept always moist, in order
 ‘ to cause them the sooner to rot. If you can have no urine,
 ‘ take common water, or dung lee ; but if you can have sea
 ‘ water, or any other salt water, it is better ; one may purchase
 ‘ at the fishmongers the pickle of herrings, also the brine of
 ‘ salt meat ; for all the brine wherein meat has lain, turns to
 ‘ saltpetre.

‘ When you have filled the pit full, and it is well putrified,
 ‘ wet it no more, but let it lie so long till all is dry. Then, if
 ‘ you

‘ you have occasion for money, look out for a saltpetre boiler,
 ‘ and bargain with him what you shall give him to lee, boil,
 ‘ and sell your saltpetre. When he has done this, let the salt-
 ‘ petre earth that’s boiled out, be flung again into the pit, with
 ‘ the lee which did not shoot to saltpetre, and let it lie one or
 ‘ two years, and pour sometimes some urine on it, or for want
 ‘ of that, common water; for that earth will yield saltpetre
 ‘ again, tho’ not so much as it did the first time.

‘ But if you have no need for money, then let that treasure
 ‘ lie, and as often as it is dry, moisten it, to make the saltpetre
 ‘ grow and increase more and more; and thus you may gather
 ‘ a hidden treasure, and hardly know which way you come by
 ‘ it: if you do not want it, your children will find it; thieves
 ‘ will not rob you thereof, nor will the plunderers in time of
 ‘ war carry it along with them. When you have filled one
 ‘ pit you may make another near it, to prevent the above
 ‘ specified things from being flung away in waste; and if in
 ‘ every village there were but one that would do this, the pro-
 ‘ duce in a small country would amount to a surprizing quan-
 ‘ tity in a year, for the service of the publick; and there
 ‘ would never be want of saltpetre.

‘ As soon as the saltpetre is ready, your money is ready, and
 ‘ gold and silver not far off. This mind, and be advised; you
 ‘ will surely grow once wise, and see how blind you and your
 ‘ equals have been: but praise God first, and be serviceable to
 ‘ your neighbour; for God has given it me. I give it you,
 ‘ give also something to thy neighbour, and we are all
 ‘ helped.’

How to cleanse saltpetre.

PUT the saltpetre into a pot or crucible, set it on a good
 coal fire, ’till it is dissolved like water. Then fling on
 one pound, about the bigness of a nut of coarse pulverised
 sulphur, and it will flame; when this with the smoak is va-
 nished, then pour the saltpetre into an iron flat pan, and let it
 congeal, which it soon will do, and loses nothing; you may
 take an earthen dish for this use, and pour the melted salt-
 petre out of the iron pan into it by degrees, letting it settle to
 the dish round about, for which end you may have one that
 keeps the dish in due motion to receive the saltpetre, begining
 in the middle, and so let it spread in a circular form. The

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sediment

sediment in the iron pan will be of a reddish hue and impure, which boil, and extract only what is serviceable.

A quick cleansing of saltpetre.

IF one is in haste to have a quantity of saltpetre cleansed, either for aqua fortis or any other work, let him make a strong lee, and dissolve the saltpetre over a fire in a kettle: when all is dissolved, pour the solution through a coarse cloth into a vessel; then rinsing the kettle, boil it again so long till it is fit for shooting; then put it into a copper pan, and the clear saltpetre will shoot into crystals, and the salt remain in the lee.

Another way to cleanse saltpetre.

TAKE saltpetre, as much as you will, pour fresh water to it as much as is requisite for its solution, let it boil till all is dissolved, and a great scum raised. Then have a tub at hand, which has a hole at bottom, under this set another tub, at the bottom of the first tub put clean washed sand about six inches high, and over that a linen cloth; upon this pour the warm lee, and let it run off, and the fœces and common salt will be kept back in the cloth and sand; when it has done running, pour it again into the kettle, boil it as much as is requisite to coagulate it; pour it out in troughs or copper pans as before, and the crystals will shoot in two or three days much finer and clearer; gather these, the remaining lee put again to boil; the oftener this is repeated, the clearer the saltpetre will be. Or,

TAKE two pound of quick-lime, one pound of verdegrease, one pound of *Roman* vitriol, one pound of sal-armoniac, beat all to powder, and mix and put them together; then put the mixture into a wooden vessel, pour on it as much vinegar as is sufficient to make a solution, or for want of vinegar you may use clear water, let it turn into a lee and settle for three days; then put the saltpetre into the copper, and as much of the aforefaid lee as will cover it: boil it over a slow fire, till it is half consumed, what remains take out of the copper, and put it into another vessel, the fœces at the bottom sling away; let

let the saltpetre lee cool, and proceed as has been directed before.

Another method to purge saltpetre after the first cleansing; by Thurniser.

PUT into a clean tub sifted beech ashes, pour fresh water upon them, stir them well with a stirring stick together, and let them settle; then pour the first water off, and pour fresh water to the settled ashes; stir these as before, let them settle, repeat this so long and so often till the lee is smooth and strong enough, which you may learn by tasting a little of it on your tongue.

Then take the once cleansed saltpetre, put it into a clean copper, pour on it the ash lee about a hand high above the saltpetre, and measure the depth with any stick or rod to the bottom; then make a fire underneath, and boil it; when it boils, take the scum off with a scumming ladle, but let the lee be well drained from it, to prevent waste; and when it has boiled so much away as the lee was above the saltpetre, which you may discover by your rod or measure, then drop from your ladle a few drops upon live coals and if it glistens and emits a blue flame, it has boiled enough; but if you don't see this, then it is not boiled enough, and you must keep on boiling it till it gives a blue fire. Then take a clean vessel, that's not too deep nor too shallow, place it where it may be cool, spread over it a double or treble clean cloth, through this pour your boiled saltpetre into the vessel; then cut some splinters of fir about a span long, lay them cross one another in the vessel, and the saltpetre will shoot to them like icicles; this saltpetre changes its name, and is called saliter, or refined saltpetre.

To try the goodness of saltpetre.

LAY a little saltpetre upon an even clear table, fire it with a coal, if it crackles like common salt when put into the fire, it is a sign that it has much common salt; if it yields a fat and thick scum, it shews that it is greasy; when the saltpetre is burned, and there remain fœces, it is a sign that it contains much earth; but when it gives a quick flame and many sparks, and

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the table remains without any fœces, and burns like a clean coal without scum or cracking, it is clear. Also, if after the second boiling there is but four pound out of an hundred diminished, it is a sign the saltpetre is good.

P A R T VIII.

Several Choice CURIOSITIES.

Of the regeneration of plants.

TAKE the seed of any plant, which has been gathered in a bright and clear day, to the quantity of four pounds. This beat in a glass mortar, and put it in a phial, stop it well up, and set it by in a warm place. When this is done, choose a fine evening in the month of *May*, and prepare to catch the dew you see is like to fall that night. Take the seed out of the phial, put it in a large earthen dish, place that in a garden or field in the open air; and in order to catch more dew than what will fall into the dish, you may hang some very clean linen cloths about the gardens or fields, and gather the dew to the quantity of two gallons, by wringing it out of the linen; put all your dew in a clean glass, and put the seed which has been moistened therewith, before the sun rise, again into the phial; stop it well up, to keep it from evaporating, and put it in its former place: filtre the gathered dew thro' a whited brown paper, and then distil it till you see it free from all earthly particles; calcine the sediment, and you will have a fine salt, which is presently dissolved in the distilled dew; of this, impregnated with salt dew, pour so much into the phial upon the seed, as will cover it three fingers high at top. Then seal it with beaten glass and borax, put it into a warm damp place, or in horse dung for a month; and after the expiration thereof, you will, by examining the phial, find the seed changed into a jelly, and the spirit thereof swim at top like a fleece of several colours. Between the fleece

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and the clayish earth, you will see the dew, which is pregnated by the seed, and is united to its nature, resemble a green grass: hang these phials, well sealed, during the whole summer season in the open air, where the sun may come at them; but if it should rain remove it into a warm and dry place, till the weather is fair, and then put it again in the open air. It sometimes happens that this work is accomplished in two months time, and sometimes it will require a whole year, according to the weather.

The marks or signs by which one may know that it is come to its perfection, are these: the slimy water at bottom swells up; the spirit, together with the fleece, daily diminishes, and altogether grows thick and troubled; then you see in the glass, when the sun beams reflect upon it, innumerable delicate atoms arising, yet very tender and without colour, much like cobwebs, and like shades of the growing plant, which fall suddenly, as soon as the sun withdraws its beams from it. At last the slimy nasty matter at bottom changes into a whitish blue, out of which by degrees shoot out stalks, that branch themselves into plants and blossoms, in the nature of the seed used for this experiment; but this phænomenon is observed only in warm weather, for in cold weather it is invisible till it becomes warm again. It will retain its quality as long as the bottle is kept whole.

A fine curiosity to make metals grow visibly.

CALCINE fine and transparent pebble stones, by heating them first red hot, and quenching them in water; repeating this till you have reduced them to a fine powder. Of this take one part and two parts of tartar, which has been reduced by saltpetre; put it in a clean crucible into fusion; when cold beat it fine, strew it upon a glass table or marble, and let it in a moist place flow to an oil, or rather liquid.

Of this liquid take about four, five, or six ounces, put it in a white phial, add to it a dram and a half of metalline calx, which has been dissolved in aqua fortis; then let it evaporate till it becomes of the consistence of the calx; let this stand, and when cold, you will see the metal grow, and blanch out in twigs of different colours, according to the calx you have put in.

N. B. It

N. B. It is to be observed, that the cause of this growth is the volatile acid meeting with a fixed alcali. We may conclude this from the following experiment; take quicklime and common salt, calcine them together to an alcali, fling it on barren ground, and it will make it fertile, and cause vegetables to grow and thrive thereon, by contracting the alcali, the acid, the air, and the volatile salt.

You dissolve iron in *spiritus salis*, and abstract the spirit from it till it is dry, and there remains a fiery red mass; of this break about the bigness of a pea, put it, together with the aforementioned liquid, into a phial, and in a few hours you will see a tree in full growth, of a dark brown colour. Gold for such experiments is dissolved in aqua regis; the other metals, as silver, copper, tin and lead, are reduced by aqua fortis. The gold will produce a growth of a yellow colour; silver a blue; copper a green; tin and lead a white colour.

This affords a fine speculation, particularly to those who delight in the study of mineral productions.

Crescentia lunæ, or the philosophical lunar tree.

THE nature of the growth and increase of silver ore may visibly be demonstrated by the following representation:

Take clean settled aqua fortis six ounces, dissolve therein two or three ounces of fine corned or beaten silver, pour after this three times as much clean water on it; in this solution you put to an ounce of silver, three or four ounces of purified mercury, let it stand undisturbed in the cold, and you will plainly and distinctly see, how by the help of the spirit of tartar and nitre in the aqua fortis, the silver and mercury work conjunctively, and form variety of pleasant vegetables, prospects of hills, rocks and vallies: this is supposed to be the beginning of the growth of metal ore in the mines.

Of mines, and how to discover them.

HUMAN life would certainly have enjoyed more innocence and satisfaction, were it not for the riches and luster which nature dazzles their eyes with, and makes them indefatigable searchers into the innermost recesses of the earth, to her hidden treasures.

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Those subterraneous riches are discovered several ways:

1. When after great floods of rain the current in the several channels washes and discovers the veins of ore which nature had concealed with earth, as happened formerly at *Freyburg* in *Saxony*.

2. Sometimes metal ores are discovered after a great storm, when thereby trees are torn up by the roots that grew on the surface of gold and silver veins.

3. *Justin* relates, that *Gallicia* was very rich of copper and lead, and *Baramus* of gold, and that it has often happened that husbandmen in plowing their land, have plowed up pieces of gold ore, and thereby discovered the mines thereof. Nay, it frequently happens that mines are discovered by digging of wells.

4. *Diodorus Siculus* mentions, that by the fire the shepherds made in the woods in *Spain*, the like mines were discovered.

5. It is reported for certain that the lead mines at *Goslar*, a city in *Lower Saxony*, were first discovered by a horse beating his hoof against lead ore; and the like has been done by swine, in rooting up the ground, when they search for acorns.

But all these are merely accidental: it is better therefore to have certain rules to direct one to the discovery of such mines; which indeed are best learned by long experience; however, those that have been observed are the following.

1. When on the surface of the earth, pieces of ore of ripe metal are found, it is a certain sign that veins of ore are there. By this was the rich mine at *Kuttenberg* in *Bohemia* discover'd; a friar walking there for pleasure in a wood, found a little twig of silver, which sprang out of the ground; he was so very careful as to cover the place with his cloak, and carry the good news to his convent.

2. When there is a white frost all over the country, there will be none over the mineral veins, because they send up such warm fumes as dissolve the frost, and for this reason snow sooner melts in those places than in others.

3. It is a certain sign that minerals are found in such places where the shrubs and trees are observ'd to fade by the latter end of the spring, become spotted and of a redish colour.

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4. A hill, the foot whereof looks towards the north, and the top towards the west, holds for the most part silver ore; the silver inclining from west to north.

5. By carefully examining into the colour of the earth, one may conjecture whether there are mineral ores there: and the colour of the mineral earth will shew what metal it carries; a greenish earth denotes copper, black gives good hopes of gold and silver; but the grey and white of none but iron or lead.

6. Dry, barren, and, as it were burnt up hills, contain some metal, because all the hurtful vapours that exhale out of the mineral veins, dry up the plants.

7. When stones or earth are heavier than ordinary, it is a sign of mineral veins.

8. The springs at the bottom of hills often discover mines, either by their colour, smell, or taste, or by carrying some small metallic substance, whereby one may perceive that there are mineral veins.

9. Some, but not many, plants and trees which have sympathy with metals, grow commonly over ore mines; and give thereby notice for the discovery of them; as juniper, wild figs, and most plants of a prickly growth. When hills are always covered with vapours and smoak, it is a sign that there are metallic veins.

These are the directions which are followed by such as are in search of mineral ore, as they are set down by *Agricola*, *Cardan*, *Glauber*, and *Kircher*. This last author proceeds thus: "Lastly, we must allow, that all the signs for the discovery of mines here mentioned, are founded on a weak bottom, and that there is none of those supposed marks, whereby one can be sure and certain, after you have discovered the place that contains ore, neither what quantity, or what kind it holds; for these signs will direct as well to sulphur, antimony, salt, mercury, lead, iron, copper, tin, as to silver and gold. But by virtue of the winchel-rod, one may with confidence distinguish the one from the other, and know what kind of ore the mines contain; for by holding in each hand a piece of gold, the rod which thereby attracts the atoms of the gold, will beat or move to no other metal; with silver it will do the same. As those who profess themselves great professors of that art affirm."

How

How to search for, and find springs.

VITRUVIUS, in his treatise of architecture, takes notice of the following experiments, used in his time to discover springs; *viz.* If one would certainly know where water is to be found, he should a little before sun-rising lie flat upon his belly, and rest his chin upon the ground, looking round about him; and if he sees at any place a rising vapour or fog, in such a place he may be assur'd of water. 2. In looking for springs, one ought well to examine the condition of the earth, because in certain places you have several sorts; the water that is found in chalky grounds, is neither plentiful, nor of a good taste; that which is discovered under a light sand, after you have bestow'd much labour in digging deep enough for it, will be very little, and thereby slimy and disagreeable; black earth contains the best water, because the rain, which falls in the winter season, soaks best into such earth and (on account of its closeness) it preserves water better than spongy earth. Springs that are in dark gravel, and those not far from rivers, are also very good; tho' they afford no great plenty; but those in coarse gravel, pebble, or other stone, are more certain, and the water very good; springs in red sand are also good and strong, because the water is not soaked up as in stone quarries. Those at the bottom of hills, between rocks and stones, are the best, freshest, and most wholesome. Springs in vallies are black, heavy, faint, and disagreeable, except they have their source at some distance under the earth, or run through some shady grove of trees, whereby they are made agreeable and pleasant: as is observ'd by such as spring out in the vallies near hills.

Besides the fore-mentioned methods, there are others whereby one may conjecture the proper place to dig for springs; namely, wherever are seen (growing by themselves) small rushes, willows, and such plants which thrive no where else but in watery places, it is a sign there is water underneath them: but this is only to be observ'd in places that are free from pools, otherways rain-water may gather and occasion the growth of such plants, without the help of any springs. But if one cannot come at these trials, the following may be ventured upon, *viz.* Dig a hole, three feet wide, and three or four feet deep, after sun-set; then take a copper or lead bason, dish,

dish, cup, or what you will, anoint the inside with oil, and set it on the bottom of a hole, with the inside downwards; then fill the hole with leaves of trees, and over them put earth: the next day, when you take up your basin, and you find drops of water hang on the inside thereof, it is a sure sign there is water in that place.

Or, put an earthen pan unglaz'd in such a hole, and in the aforesaid manner; if there is water in that place, the pan will be wet and damp. Or, if you sling wool in such a hole, and you can the next morning wring water out of it, it is a sure sign of a plentiful spring.

When a lamp, lighted with a little oil, is put in such a place, and neither the wick nor the oil consum'd the next day, or the lamp damp, it is a sign of a spring, and that the lamp has been fed by the damps thereof.

Another way is, by making a fire in such a place, and when it is well heated, it will cause a thick vapour or smoak, which is a sign of water.

Cassiodorus will have it, that where subtile vapours or mists arise in perpendicular pillars, in such places one may be sure of springs, which lie as deep under ground as the pillars are high. The same author recommends also for a sure sign that which the well-diggers have, who when after sun-rise they see a swarm of gnats, as it were, in a cloud, they conclude that underneath them the earth contains springs.

Father *John Francois*, a jesuite, is of opinion, that springs are best discovered by boring, whereby the different earths under the surface may be brought up, and examined whether they have any sign of water, or not: he adds, that such gimlets might be made to bore through quarries of stone, and in case the gimlet should not be long enough, to dig four or five feet deep, and help it further that way.

Father *Kircher* gives us another method whereby to discover springs, or subterraneous water-courses, which he tried with good success, and is very easy to be put in practice: Make a balance of wood, in the shape of a needle of a compass; one end must be of a kind of wood that will easily extract moisture, as elder, willow, or the like. The needle is balanced between an axis, or is hang'd by the middle on a packthread, in places where water is supposed to be. If there really is water, the hand will soon loose the balance, and the point of the elder incline

incline towards the ground. This experiment is (says he) to be made in the morning early before the sun has dispersed the vapours of the earth.

These are the best of the common methods, which I know, to discover water springs; but how curious and ingenious however they are, the searcher is often deceiv'd by them. Father *Kircher's* method, indeed is the easiest; but his project is not so much for discovering of springs, as to determine whether there is any water in that place.

But the *winchel-rod* is the most wonderful invention for that purpose that has yet been discovered, and the operation thereof is surprizing; for by virtue of a hazel-rod or stick, not only the springs, but also their depth is easily discovered to a great nicety. Father *de Charles*, who made himself famous on account of writing a book intitl'd *Mundus Subterraneus*, after he has enumerated several ways of discovering springs, concludes thus; "There is another method to search for water, " which is the most wonderful of all; but every one has not " the capacity of putting it in practice. The whole mystery " consists in this; a fork'd twig is cut of a hazel or mulberry- " tree, and he who searches carries it loose in his hand, but as " soon as he goes over a spring, he will observe the stick to " turn in his hand, and incline to the place where the spring " is." A large account of this and the foregoing matter, is given by the author of the *accurate description of the winchel-rod*, written in *High Dutch*.

A Camera Obscura.

CHOOOSE for this experiment an apartment, from which you may have a prospect into fine garden-walks or other places of resort; contrive a hole, either through the wall or else in a board fixed in the window, in which fix a round glass of a pair of spectacles, and exclude all other light out of the room, but what enters through that glass: then at a convenient distance fix a sheet of white paper or white cloth, and you will with delight see the objects without represented thereon in their lively colours, especially in a bright sun-shiny day, you will see the birds in the air flying, ships (if you have such a prospect) sailing, people walking, coaches going, and every thing else appear in such beauty and order, as will excite your admiration

admiration to consider how the colours are disposed in their proper shades and attitudes; and how, when two different colours meet, the one is not changed by the conjunction of the other; besides other speculations it may afford, both useful and entertaining.

It is to be observed, that all the images which fall through the glass upon the paper, cloth or white wall, appear upside-down; and to have them represented upright, the following experiments have been approved of, the first is, by fixing another glass of a larger circumference at the outside of the apartment, before the other glass is fixed; this may be done when the two glasses are fix'd in a proper frame or tube made of wood or tin, for then they may easily be fix'd into a hole made for that purpose in the window-shutter or wall, but the objects will not appear so plain and clear as through a single glass.

We will here present the curious with a model and description of a moveable *camera obscura*, whereby he may draw things relating either to orthography or ichnography, to the greatest perfection. The machine is prepared with as little trouble as expence, in the following manner.

Make a cubical or an even-sided frame, and close all the sides round with thick paste-board; in one of the sides make a little hole, wherein fix a glass through which the images of the prospect may enter; fix a white paper opposite to the glass at a proper distance, and having made a little hole near the glass, you may through that see the objects in a beautiful manner on the paper, which enter through the glass.

To illuminate an apartment with various beautiful colours.

PUT three or four prisms, or glasses together in a triangular form in a frame, so as to make it portable, as you see in the figure A, B; let the prisms be so fix'd to your corners, that on one side they may make a flat, and on the other a trigonal face, as in the figure; place this frame thus finished under a window towards the sun, so that the flat side be towards it, and if there be any more windows in the apartment, let them be shut up. As soon as the beams of the sun shine through these trigonal glasses, your apartment will appear like

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a paradise in the greatest beauty, and of various colours. If you receive these beams on a concave glass, you will see the colours change quite different from what they were before; and if you look through those glasses into the street, you will see every thing in different colours, so that you will be in a sort of surprize or admiration.

Diana, or the philosophical tree.

THIS operation is mixture of silver, mercury and spirit of nitre, crySTALLIZED together in the shape and form of a tree.

Take one ounce of silver, and dissolve it in two or three ounces of spirit of nitre; put the solution into a matrafs, or glass phial, into which you have put 18 or 20 ounces of water, and two ounces of quicksilver. Let your phial be filled up to the neck, and place it in some convenient place where no body can meddle with it, for 40 days together, in which time you will see a tree spread forth in branches, with little balls at the ends thereof.

Another method.

DISSOLVE an ounce of fine silver in three ounces of aqua-fortis, in a phial or small matrafs; evaporate about half that moisture in a warm sand by a gentle fire; then add to it three ounces of good distill'd vinegar, heat it a little, and stir it about; then put your matrafs in a safe place, where it may rest for a month, and you will see a tree growing to the very surface of the liquor, and resemble in its branches a fir-tree.

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Curious

Curious Secrets for preserving Things from CORRUPTION.

To preserve things from corruption in spirit of wine.

THIS is done in the most subtle rectified spirit of wine camphoriz'd; wherein many sorts of animals, as birds, fishes, insects, reptiles, &c. may be kept many years from decaying or corruption. *Porta* relates, he had seen a fish at *Rome* thus preserv'd for above 20 years, which was as fresh as if alive: likewise at *Florence* he saw one that had been preserv'd above 40 years. The glasses, wherein they were kept, were hermetically sealed, to keep the least air from coming to them.

The preparation of the spirit or oil of salt, whereby things may be kept from corruption, and which is a great restorer and preserver of health.

TAKE sea-salt, as much as you please, put it into a pan or crucible covered, over a good coal fire, and when it has done crackling, take it off, put it in a damp place till it is dissolved, filter it often through a paper, till it is thoroughly clear and fine. Then let it digest in horse-dung, for about two months, changing the dung often for fresh, in order to keep it continually warm. Then distil it over some sand, and you will have in your receiver a salt oil, with a watery phlegm, distil this gently in a *baln.* and the oil will remain behind; but the watery substance be carried off; whatever is put into this oil, will keep from corruption without changing, for ages. This is the salt spirit which by *Paracelsus* is called *Vividitas Salis*, and has incomparable virtues, as well to restore men to health and vigour, as also to preserve them from most distempers; four or six drops taken in wormwood water, is good for the dropsy, convulsions, and the yellow jaundice;
three

three or four drops taken in harts-horn-water is good for all sorts of agues; for worms, it is taken in brandy; three drops taken in *Carcit*, or water of *Carduus Benedictus*, it is good for the stoppage of urine. It is a fine remedy for all sorts of sprains and contractions of the nerves; it heals bruises and swellings, when mix'd with other ointments, and the affected parts are anointed therewith. When mix'd with oil of turpentine or wax, or camomile, it will assuage the gout. This oil, or spirit of salt, if well rectified, is a solvent for all sorts of metals and stones, and a key to many hidden mysteries.

But if this preservative is too costly to keep things from corruption; you may prepare a sea-water with a small expence; which will keep things for many years; and this you may do in the following manner:

After you have searfed your sea-salt, dissolve it in distilled rain-water, and make thereof a lee which will bear an egg.

Or, when the salt is searfed, put it into a damp place, and when it is dissolv'd, filter it through a paper so long till it is clear and fine. This you may use to preserve things from corruption, by distilling it, and pouring it over the thing to be preserved.

A regeneration of coral.

TAKE verdegrease three pound; live sulphur one pound; clear sand four pound, pulverise and mix them; then distil them in a retort on sand, first with a slow fire, but augmenting it by degrees, it will produce a spirit, which has a sweetish sour flavour.

If you pour this spirit upon powdered coral, or harts-horn shavings, which by a gentle warmth is quite dry'd up, then you put it into a phial with some distilled rain-water, and set it in a warm place well closed up, the coral or harts-horn will shoot and grow so natural that it will be a delightful sight.

To prepare a phosphorus.

TAKE urine, as much as you please, put it into a tub or kettle, let it stand for three weeks or a month together and putrify, then boil away the humidity till the remainder becomes a black and tough matter. Of this take one pound, oil of tartar foetid, or the stinking oil of harts-horn, or for want of that, green wax; mix it well with the matter, put it into a retort, let it on a strong fire of a reverberatory furnace, fit to it a large receiver, lute the junctures, give first a gentle, and lastly for four hours the fiercest heat you can; and you will find in the receiver, in the first sediment, the volatile salt, then some oil, and after that the phosphorus, which in the receiver, is sublimated of a yellowish colour; let the first sediment stand over night and grow cold, then take and wash with the liquor that is at the bottom, all the phosphorus and oil, mix them well together, put them into a matrafs, distil them out of a sand coppel, and you will find in the first sediment grains of phosphorus, which whilst warm form into little sticks, and preserve them in a little phial as the former.

Another process of making the phosphorus.

TAKE a considerable quantity of human urine, digest it for a pretty while, before you use it, then distil this liquor with a moderate heat, till the spirituous saline parts are drawn off; after which the superfluous moisture will evaporate, and what remains in substance, be brought to the consistence of a syrup; incorporate this with thrice its weight of fine white sand, and put it in a strong stone retort; to which join a large receiver, fill'd in a great measure with water, so that the nose of the retort may almost touch the water; then lute the two vessels carefully together, give it a graduated fire for 5 or 6 hours, to bring over all that is phlegmatic or volatile; this done, encrease the fire, and at last for 5 or 6 hours more make it strong and intense as possible you can, by which means there will first come over a large quantity of white fumes, which in a little time will be succeeded by another sort seeming to yield a faint blueish light in the receiver; lastly, the fire being vehement, there will come
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over another substance more ponderous than the former, and fall to the bottom of the receiver, which you take out and preserve, and which is the real phosphorus.

Another such luminous matter.

TAKE what by most apothecaries is called land emerald, as much as you will, beat it fine with water on a stone; temper it with gum or honey-water, and write or paint there-with upon a polished copper or iron plate, whatever you will, and let it dry; then lay it upon a charcoal fire, or set it before the same, and in a little while it will shine, so that when you bring it into a dark room, or put the candles out, the company who are ignorant of what is done, will be surpris'd at so sudden and strange an appearance.

To prepare a room or closet in such a manner that any one entering with a lighted candle, will think himself surrounded by fire.

TAKE a pretty large quantity of brandy, and put it in a bowl; set it on a slow coal fire, to receive heat enough to boil it gently up; into brandy fling some camphire, cut in little bits, which will soon dissolve, and when all is dissolved, close both windows and doors, and let the brandy boil and evaporate; by this the whole soon will be filled with subtle spirits, which, as soon as a candle is brought in, will be lighted, and seem as if all was on fire. If some perfume is dissolved in the brandy, the flame will be attended with a fine scent.

To prepare a luminous stone.

TAKE good rectified spirit of nitre, fling quick lime and chalk into it, till the said spirit can dissolve no more, and ceases to bubble; filter the solution, put it into a retort, and distil the spirit of nitre from it again; what remains in the retort place in the air, and let it dissolve; then put it again into the retort, draw off the moisture, till it is dry; set it again in the air, and let it dissolve; then put it into assay-cups, put them into a cucurbit, and distil all the moisture

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from it; what remains put under a muffel to harden. Then hold it in the light of day, of the moon, or the light of a candle, and it will extract that light, so as to emit it again, when put into a dark place.

The preparation of a phosphorus.

TAKE an earthen plate or dish, which is not glazed, about half an inch thick; and make a sort of paste of spirit of nitre and pulveriz'd chalk, well stirred together; of this take the bigness of a shilling, put it into the plate, and set it on the fire under a muffel (where it will bubble very much) to dry; when dry, take it out, let it cool, and mix it up with spirit of nitre; this do six or eight times, and it is done: after it is cold, hold it a little while against a candle, and shewing it in a dark place, you will be surprized at the light it gives.

How to prepare thunder powder.

THIS is done with three ingredients, namely, three parts saltpetre, two parts of salt of tartar, and one part of sulphur; these are pounded and mixt together: if you take about 60 grains in a spoon and warm it over a candle or other fire, it will give a report, like a cannon fired off, and the flashing will beat downwards; if you make use of a copper spoon or cup, you will after the report find a hole at bottom; but when fired at top, it will burn away like lightning.

To prepare a stone, which being wetted produces fire.

TAKE quick-lime, saltpetre, tutia alexandrina, calamint of equal quantities; live sulphur and camphire of each two parts, beat them fine and sift them thro' a fine sieve, then put the powder in a new linen cloth, tie it close; put it into a crucible, cover it with another crucible, mouth to mouth, bind and lute them well, then set them in the sun to dry: when dry the powder will be yellow. Then put the crucible in a potter's furnace, and when cold again take it out and you will find the powder altered into the substance of a brick; this you may form into less proportions, and when you have occasion to

to light a candle or fire, wet part of it with a little water or your own spittle, and it will instantly flame: when you have lighted your fire, you may blow it out again as you do a candle.

To represent a philosophical tree in a glass.

TAKE of the finest silver one ounce, aqua fortis and mercury of each four ounces; in this dissolve your silver in a phial, and after you have put over it a pint of water, close your phial, and you will see a fine tree spring forth in branches, which will increase and grow thicker every day.

To represent the four elements in a glass phial.

FIRST tincture in a phial, good spirit of wine with *Terra Solis*, to represent the air; then take well rectified oil of turpentine, this you are to tincture with saffron, and red ox-tongue root for fire; oil of tartar, to which you must add a little ultramarine, to give it the colour of sea water; and to represent the earth, take a little smalt. This you may shake together, and after it has stood a little, every thing will take its place again, for the three liquids will never keep or unite together. Or,

HAVE a glass made in the shape of an egg, fill the fourth part thereof with clean smalt, or common antimony, (a) to represent the earth; for water (b) take spirit of tartar; for the air (c) spirit of wine three times rectified, and oil of *Benjamin*, which in colour and brightness may represent the fire; (d) the cover of the glass may be ornamented with a flame, or what you please.

A Florence flask will answer the same purpose made with a foot to it, as you see in the figure.

An elementary world in a phial.

TAKE black glass or enamel, beat it to a middling gravel size; this, for representing the earth, will settle at the bottom, for the water you may use calcined tartar, or sand ashes, which you must first moisten, and what thereof dissolves

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pour the clearest into the phial, and tincture it with a little ultramarine, to give it the sea colour; for the air use aqua vitæ, the best you can get, which when tinctured with a little turnsole, gives a sky colour; to represent the fire, take linseed or oil of turpentine, and prepare the latter thus: distil turpentine in *baln. mar.* the water and oil will rise transparently together, but the oil will afterwards swim at top, which take, after you have coloured it with ox tongue and saffron. All these materials differ both in weight and quality, for if you shake them together, you may indeed observe a little while a chaos full of confusion and disorder, but as soon as you set the phial down, each ingredient takes its respective place in the same order as before.

To ornament a room with a continual moving picture.

PLACE a large picture against a wainscot, in a summer house, or any other room where the wind may be convey'd to the back of the picture; bore little holes through the wainscot, to correspond with some paste-board wheels that are at the back of the picture; the wind which blows on them thro' the little holes, will put them in motion, and having on the right side of the picture such things painted and fixed to the paste-board wheel on the spindle, they will have an equal motion with them: and there may be several things represented in a picture, and their motion made agreeable; as for example, a man grinding of knives, a woman at her spinning-wheel, a wind or water mill, and several other fancies; as a man's curiosity will direct him to.

To make microscopes to a great perfection.

TAKE a lamp with spirits of wine, and instead of cotton use very small silver wire, doubled up like a skean of thread: then take of beaten glass, after it is well wash'd and cleansed a little quantity on the point of a silver needle filed very small and wetted with spittle, then hold the bit of glass in the frame of the lamp, till it is quite round, but no longer, for fear of burning it; and if the side of the glass, next the needle is not melted, then turn the rough side to the flame, 'till it is every where equally round and smooth, then wipe and rub it with soft leather, and afterwards put it between two pieces of thin brass, the apertures must be very round, and that
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towards the eye almost as large as the diameter of the glass, and so place it in a frame with the object.

Of the Regeneration of ANIMALS.

Of Craw-fish.

IT is to be observed that if you will succeed in this experiment, you must choote the full moon, and, if possible, when in a watry sign; then take a parcel of live craw fish, which are caught in rivulets and brooks, divide them in two parcels; one parcel put into an unglazed earthen pan, lute it well, and put it into a furnace to calcine for seven or eight hours in a strong fire: after they are well calcined, beat them in a marble mortar to powder: then take the other parcel, and boil them in the same water they were caught in, pour off the water into another vessel, about half a pail full, and fling into it about half a handful of the calcined craw-fish, stir it well together with a stick, then let it settle and remain quiet, and in a few days you will observe in the water a great number of small atoms in motion. When you see them grow up to the bigness of a small button, you must feed them with beef blood, flinging thereof by little and little into the water, which will cause them to thrive, and to grow to their natural bigness; but you must observe that before you put them into the vessel with water, you are to lay sand at the bottom about an inch thick.

Petro Borelli, in the 34th paragraph of his physical history says, ‘ If one takes the ashes of craw-fish, and lay them
‘ in a damp place or in an earthen pan, moistened with a little
‘ water, and lets it stand, in less than 20 days there will be
‘ seen innumerable little worms; and after this you sprinkle
‘ beef blood upon it, they will by degrees turn into craw-
‘ fish.’

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The *Sieur Pegarius*, where he treats upon this subject, says,
 'As to the generation of animals, a friend of mine did see
 'the figures and shapes of craw fish, in a lee he made of cal-
 'cined ones; but what is more surprising, out of such a salt
 'not only the resemblance of such creatures is produced, but
 'also the very animal itself, alive and in its natural form and
 'shape; as *D. de Chambulan* and others have experienced, by
 'flinging the powder of calcined craw fish into standing water;
 'the like may be done with the ashes of toads. *Rochos*, in
 'his *Art of Nature* writes, that out of a rotten duck have
 'grown several toads, because she had fed upon these crea-
 'tures; and that the carcass of an owl, which has fed upon
 'jacks, will bring forth great numbers of that fish after it is
 'rotten; and if the said owl has fed upon carps, the rotten
 'carcass will produce carp: and from hence it is, that when
 'a fish pond is quite dried up, and water is again let in, it will
 'abound in a little time with fish of such sort as never were
 'in before.'

Of eels.

KIRCHER, in the first part of his subterraneous world,
 speaks thus of eels.

Eels grow without a sperm or seed, out of the skin they
 throw off yearly, which corrupts; or of what sticks to the
 stones against which they rub; the truth of this may be easily
 experienced, by chopping an eel into little pieces, and flinging
 them into a muddy pond, for in a month's time there will
 appear a brood of small eels.

Another generation of eels is performed thus: take two
 pieces of turf, let them lie that the dew may fall upon them,
 then lay them grass to grass, and put them into a pond, or
 ditch, so that the water may play upon them, and you will see
 first little worms come from between, which in time will grow
 up to eels.

According to *Aristotle*, there is neither male nor female of
 eels, neither do they copulate, or spawn, and there never is an
 eel found with either a hard or soft roe; from all which it may
 be conjectured, that when a slimy water has been quite drained
 off and the slime been taken out, there has still been a pro-
 duction of eels when fresh water has been let in again; for in

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a dry foil they do not generate, nor in the sea that is always full of water, because they have their growth and nourishment from rain.

They are also generated out of other corruptible things, and we have seen, when a dead horse has been flung into the water, a vast number of eels have been perceived about the carcasses; and it is thought they come forth from other dead carcasses also. *Aristotle* says, they have their first origin in the inner recesses of the earth, where some of them break out into the sea, or others in rivers and ponds.

That vegetables produce all sorts of insects, and in particular flies, we find in *Aldrovandus's* third book of reptiles, where, chap. 16, he says thus: 'As I will not deny that out of the most putrified matters, even out of carrion, grow flies, I do believe that most of them have their origin from vegetables, as we have examples of our own experience; for a few years ago, in a winter season, when, for want of other green plants, I pounded brown cabbage, and left them some time in my room, I found that worms grew out of them, and that these worms turned into lady-birds; I gathered them into a box; and opening the box some time after, a great swarm of little flies flew out of it, which before had been lady-birds.'

Something of the same kind did a good friend and correspondent communicate to me in a letter, *Dec. 28th, 1671*. He writes thus: 'I once read in an *Italian* author, that out of *Cheledonia* a tincture could be prepared; this did prompt me to make a stricter search into the nature of that herb; I took the whole plant, chopped it fine, when it was full of juice, and put it into a matrafs; then I luted a head upon it, thinking to distil it in *Bal. Mar.* but by some accident it remained almost a whole summer neglected in my laboratory. Towards autumn I found that the whole mass was liquified and full of worms; hence I could easily perceive what a fine tincture I had to expect; however, I let it stand the whole winter; in the beginning of the spring, I found that the worms were all gone, and all was turned into a black powder; not long after, out of this powder grew gnats, in such abundance, that the whole glass was full of them, which made a buzzing noise and flew about. I was in the interim visited by an acquaintance, who spied the glass with the gnats as

‘ as it stood in the window; we fell into a discourse about
 ‘ them, when he maintained that those gnats would not bear
 ‘ the open air, but die as soon as it was conveyed to them.
 ‘ I could hardly believe it, but to try the experiment, I
 ‘ pulled the stopple out of the retort, and perceived all the
 ‘ gnats dead in a moment; after I opened the glass, I found
 ‘ that most of the powder was turned into gnats, except a
 ‘ very little black earth, which I tried and found the taste
 ‘ very fiery, and produced, after it was lighted, a fixed salt,
 ‘ which, without doubt, may have its particular virtue.’

Scaliger says, that every tree and herb has its particular worm or insect, and almost every small vegetable its own fly. This a virtuosi at *Rome* observed in his garden, and had them painted together with the plant in their natural colours; but we need not go so far as *Rome*, we may satisfy our curiosity by perusing Mr. *Albine*’s natural history of *English* insects.

Peganus’s relation of what happened, with his experiment, in the generation of serpents.

‘ **W**HEN, anno 1654, among other authors, I happened
 ‘ to read *Theophrastus*’s book *de Vermibus*, where he,
 ‘ in particular, gives a surprising account of the *German* not-
 ‘ ters (vipers) and having a desire to try the experiment of so
 ‘ great a curiosity, I ordered 25 notters to be caught; I had
 ‘ them skinned, flung the heads and tails away, and saved the
 ‘ heart and liver for a particular use, after I had made them
 ‘ into powder, the flesh and bone I cut in little pieces, put
 ‘ them into a glass matrafs, set over that another, and luted
 ‘ them close together.

‘ This I did in *July*, in my laboratory, at the window where
 ‘ the sun only shined a few hours upon it; I let it stand for
 ‘ two months, and observed every day whether there appeared
 ‘ any change in the glass; after a few weeks I saw some oily
 ‘ or greasy drops hang to the upper glass, which were of a yel-
 ‘ lowish colour; after I had looked with great attention upon
 ‘ these drops for an hour together, I observed issuing out of them
 ‘ snow-white worms, very small, which crept downwards; and
 ‘ as these worms encreased daily more and more, the first of
 ‘ them grew bigger, but the matter at the bottom of the glass
 ‘ stood like a yellowish oil with some watry moisture, and the
 ‘ sedi-

‘ sediment at the bottom appeared to be a black earthy
 ‘ substance; after some weeks the number of worms began
 ‘ to decrease, the rest increased in growth; and at last they
 ‘ were all vanished to three or four, which were about a
 ‘ finger’s length, and had an uncommon brightness. In a
 ‘ few weeks they were all lost except one, which was pretty
 ‘ long, and had the resemblance of a serpent, but was of a
 ‘ snow-white colour, smooth and shining, without scales,
 ‘ although there were very subtle black lineaments across,
 ‘ which in the glass I could not well distinguish; the head
 ‘ differed also something from that of a serpent, the rest
 ‘ of the mass grew dry, and resembled a black close earth:
 ‘ I was in one respect rejoiced to have the happiness of
 ‘ seeing this curiosity of nature, in regenerating a serpent,
 ‘ but on the other hand I was cautious how to bring the
 ‘ creature out of the glass, and how to proceed further there-
 ‘ with; at last fear got the upperhand of reason, and in a
 ‘ sort of horror I took the glass and flung it into an house of
 ‘ office.’

Of the generation of silk-worms out of veal.

TAKE about ten or twelve pound of veal, all meat without bones, warm, and as soon as it is killed; chop this with a chopping-knife as fine as you can, afterwards put it into a new earthen pot, thus: at the bottom make a layer of mulberry-leaves, then a layer of veal, and thus proceed till your pot is full; then cover the top with mulberry-leaves, and take an old shirt, which has been well wore and sweated in by a labouring man; put this at top upon the leaves, and then tie the pot close with leather. After this is done, set the pot into a cellar, which is not too cool, but something warm and damp, let it stand for three or four weeks, till the veal turns into maggots, which happens sometimes sooner, sometimes later, according to the nature of the place into which you put it. Of these maggots take as many as you will, and set them upon fresh mulberry-leaves, which they will eat; change their form to silk-worms; they will soon content themselves with that nutriment, and spin and generate like other silk-worms. I have produced them twice, not without the admiration of the late Mr. *Sperling*, and yet I am of opinion that this generation

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is not of both, but only of one kind; the same opinion I have of toads or frogs, which are produced out of barren earth.

The time wherein silk-worms are to be raised, is in the beginning of *July*, to the eighth of that month, when the process is to begin. *Vida*, in his second book of silk-worms teaches, when a young ox is fed with mulberry-leaves that out of his flesh, after he is killed, will grow silk-worms*.

A particular method to furnish a fish-pond with variety of fish.

TAKE about the latter end of *April*, or the beginning of *May*, the root of a willow that stands near the water side, and is full of fibres; wash the earth about it clean away: then tie it to a spike, which drive into a river or fish-pond, that is well stored with variety of fish: they will presently strike about and against the root, and void their spawn or row, which will hang to the fibres; after a few days take the spike with the willow-root out of that river or fish-pond, and convey it to that which you design to store, driving it about a hand's breadth deep under the surface of the water, and in about a fortnight's time you will perceive a great number of young fishes. Be careful that you leave the root not too long in the first pond or river; lest the heat of the sun animate the spawn, and so it disengages from the root.

* Since the publication of the second edition, we have met with an authentic account, in the *Breslaw Philosophical Collections*, of a process made by Dr. *Lanckisch*, Physician at *Lignitz*, in *Silesia*, in the nicest manner; but after having tried various experiments for several summers successively, he never could produce any real silk-worms, but the putrefaction of the veal he has prepared, according to the directions given before, turned first into large maggots, and having spun themselves into chrysolites, they became afterwards beautiful large flies. But as the above account is attested by several credible authors, we would not omit it in this edition, for the further search and enquiry of the curious.

PART

PART IX.

Several curious and useful Instructions in the Art
of DISTILLING.*How to extract the quintessence of roses.*

TAKE fresh roses, which are gathered before sunrising, whilst the dew is upon them; bruise or stamp the leaves thereof in a stone mortar, then put them into an earthen glazed pan or bowl; cover them close, and let them stand till they putrify, which you may perceive when the scent thereof is sour, and it turns so in about twelve or fourteen days; you may mix up with the leaves a little salt of tartar, for this penetrates, cuts, and separates the contrary particles, and will cause each the better to separate.

After the rose-leaves are thus putrified, take the fifth or seventh part of them, put them into a glass cucurbit, and distil them in *Baln. Mar.* Pour the distilled water upon the other part of the leaves, and after you have emptied the cucurbit of the first leaves, put in the second part, and distil them in *Baln. Mar.* as before; thus repeating it you will draw a rectified water which contains the spirit, and must be separated in the following manner; put all the water you have distilled into a matrafs with a long neck, and a head to it, lute a receiver to it; then with a slow ash-fire draw off the spirit; and as there will go some of the phlegm along with it, the spirit must be together with the phlegm distilled again with a slower fire; and thus you will have a pure spirit of roses, which will diffuse its strong scent as soon as the matrafs is opened, over the whole room.

Save this spirit, well closed up in a phial, as a precious and valuable thing; for its virtue is wonderful and admirable. Pour the greater part of the distilled rose-water over the already distilled rose-leaves, in order to extract the oil from the water; which

which must be done by distilling it over a hotter ash-fire than you did the spirit: the oil will separate itself from the phlegm, and swim on the surface of the water in a gold colour; and although the quantity be but small, the virtue thereof is great and valuable.

Separate this oil from the phlegm, and put it up apart by itself, and also the distilled rose-water in a glass by itself; after which take the distilled rose-leaves, from which all the spirit and oil is extracted, burn them in a crucible to ashes, and in burning add a little sulphur to them, give the ashes a fierce fire, and they will be as white as snow.

These ashes put into a glass or earthen vessel, pour over them the above phlegm or rose-water; boil it well, so long till the water has extracted all the salt from the ashes; then filter it through a brown paper into a matrafs; distil it, and carry off the phlegm, and a clear salt will settle at the bottom of the matrafs: the ashes you may calcine anew in a strong reverberatory fire, then boil them up again in the phlegm, and draw out the salt, as before; repeat this till all the salt is extracted, and there remains only a poor earthy substance.

In this manner are extracted from roses the three pure capital principles, *viz.* spirit, oil, and salt; and the three impure parts, phlegm, water, and *Cap. Mort.*

In case the salt should not be clean enough, you must dissolve it again in the phlegm, and repeat your process by distillation, as before, and you may make it as fine as you will.

Each of these substances apart has great medicinal virtues, but much more if all three are united together, which is done in the following manner:

Put the clear salt into a glass phial with a long neck, and set it in a gentle warmth; pour on it some of the oil, and continue the warmth till the salt and oil are united; then put another part of oil to it, and thus by uniting them by degrees, your boiling is finished. Then add to it one part of the spirit, and augment the quantity by slow degrees, as you did with the oil; and the three substances will be united, that no art is able to part them, and the medicinal virtues thereof are inexpressible.

Another

Another method to extract the quintessence out of any vegetables.

TAKE a plant, herb, or flower in the month they flourish best; gather thereof before sun-rising (with the dew upon it) what quantity you please; chop it fine, and fill therewith a glass matrafs; lute the head over it, and place the matrafs in *baln. mar.* let it digest over a very slow fire for a fortnight, after which time augment your fire; when you find some of the menstruum will go over into the receiver, then take your matrafs out of the *balneum*, and you will see the herb infused in its own juice, which pour off into a clean glass; what remains of the herb take out of the matrafs, burn it to ashes, and extract the salt thereof with a water distill'd from the same herb.

How to extract oil of herbs, flowers or seeds.

FILL a large cucurbit with herbs, flowers, seeds, or what you please, infuse it in good *spiritus salis*, set it in sand, and give it fire enough to boil, and the oil, as well as the phlegm, will distil over into the receiver; which you may separate as has been directed; the spirit you are to pour off, rectify it, and you may use it again for the like process.

A curious secret to distil herbs, so that the water will retain both the colour and taste thereof.

TAKE the leaves of the herb you design to distil, infuse them for a night and day in rain-water, then take a still head, pour into it some of the water from off the herbs, swing or rince it about, and pour it through the pipe on the herbs again; fling more fresh leaves upon it, put on the head, lute it close, and distil it in *baln. mar.* with a slow fire, and you will see the drops, which have the colour of the herb or flower. When you have distill'd it all over into the receiver, then burn the leaves or ashes, and extract the salt from it in the manner above directed; put half of it into the distilled water, let it dissolve in the sun, and the colour will be clear and fine.

R

T_o

To make vinegar of wine.

1. **F**LING pieces of barley-bread into your cask of wine, and in two or three days it will be four.

2. Take rye-flour, mix it into a dough with strong white-wine vinegar, then bake it in an oven, then beat it to a powder, mix it again into a dough, bake it, and thus repeat it the third time; whereupon put those cakes in wine and it will instantly begin to grow four.

3. Soak the best tartar nine or ten days in good vinegar, then dry it in the sun, when dry soak it again for ten days in vinegar, and being dry'd beat it to a fine powder; of this take as much as will lie on the point of a knife, mixed with a quart of wine, and it will in a little while turn it to vinegar.

4. Take one pound of raisins, clear them from the stalks, and put them into a glazed pan or pot, in a quart of good vinegar, let them soak over-night on hot ashes, boil them in the morning a little, then take it off the fire, let it stand and cool of itself; strain it and keep it for use.

5. Take iron or steel, quench it five or six times in vinegar, and it will become very sharp.

6. Salt, pepper and leaven put together into wine and stirred about will soon turn it into vinegar.

To prepare a fixed salt out of vegetables.

TAKE herbs, what quantity you please (those that shoot up in long stalks are the best for this purpose;) burn them to ashes in an open place, or upon the hearth; take off the ashes and put as much as you will into a kettle; pour water upon it, and let it boil; then filter the lee through a linen rag, and pour fresh water on the remaining ashes; boil and filter it as before, and this continue to repeat till you can perceive no sharpness in the ashes.

Then pour all the lee into one kettle, and boil it over a fierce fire, till the salt remains dry at the bottom; of this take

12 ounces, yellow brimstone two ounces, both well pulverised, and mixed together; put some of this into the iron caldron which is made pretty hot, and in which you before boiled your salt; let the brimstone burn gently away, taking care not to make the caldron too hot, lest it should occasion the salt to melt, which to prevent stir the matter continually, whilst the sulphur is burning, with a spatula: when you find the sulphur consumed, put what remains upon a clean paper; put more of the mixture into the caldron and proceed as before, till you have burned all the sulphur; then put them with sulphur salt calcined all together into the the caldron, and make it red hot; so that if there should be any sulphur left, it may be consumed, and the salt become of a whitish-grey colour; then take it off the fire, pour, whilst it is hot, cold water to it, and it will dissolve it immediately; then filter it through a brown paste-board or paper; if the sulphur is all clear from it, the solution will be of a whitish yellow, if not, it will either be green or of an iron grey.

This filtrated solution pour again into the clean caldron, set it upon a wind-furnace, draw it off dry, and give it so long a fire till the salt is red hot; when so, pour again quickly some water upon it, and it will dissolve; repeat this till by taking a little of the solution into a spoon, and holding it in the light, you see not the least film or speck on the surface thereof; but if you do, take it off the fire, and filtrate it into a clean cucurbit, set it in warm sand, and let it evaporate, without giving it the least motion, and in two or three days, according to the quantity of the salt, it will shoot into fine crystals, and when it has done crystallising, there settles a crystalline crust upon the surface; let it cool, take out the crystal, and the remaining liquor place again upon the warm sand, to evaporate and shoot into crystals.

You must observe not to be too sparing with the water which you pour upon the red hot salt, before you filter it, else the salt would settle at the bottom, and shoot no crystals.

If it should happen, that in burning the brimstone your salt should dissolve, then take it off the fire, let it cool, and beat it in a mortar; and after you have dissolved and calcined it, burn it once again with the sulphur, and then use it with the rest.

The burned ashes of green herbs, or of such as are not too dry, yield more fixed salt than such as are dried.

R 2

Soap

Soap of Naples.

TAKE the suet of a cow or calf, and put it into an earthen vessel with a close cover: melt and strain it through a coarse cloth, then pour upon it with discretion the first and strongest soapmakers lee; stir it and set it in the sun, and let it stand all night in the open air, only take heed to keep it from being wetted: when you perceive it somewhat dry, put some of the second and third sort of lee to it; then let it stand, and if by rubbing a little on the palm of your hand you see it froth, it is a sign that it is done to perfection.

Balls to take out spots of oil or grease.

TAKE soft soap; incorporate it with the ashes of vines finely sifted, of one as much as the other; then add to it roach-allum burned, and tartar finely powder'd; stir all well together, and form it into balls, with which you may take spots out of any garment.

PART

PART X.

Several Secrets relating to MARBLE.

How to stain marble that is white, and paint upon it with various colours; which may penetrate into the stone so as to bear polishing.

TAKE aqua fortis two ounces, sal-armoniac one ounce, of high rectified spirit of wine four drams; then take some gold, make it of an amalgama with mercury or quicksilver, let the mercury evaporate, and the gold will remain at the bottom of your crucible like a brown powder or calx; dissolve this in aqua regis, and evaporate it till it is of a yellow colour; then pour on the sal-armoniac and the spirit of wine, and when dissolved, evaporate the spirit again, and there remains a bright gold colour.

Calcine the silver in a phial, and then let the aqua fortis evaporate until you have a sky colour, which take off and preserve in a clean phial, keeping the rest in a warm sand to evaporate, and you will have a deep blue, which you also preserve; the remains will, by more evaporating, turn into black.

By mixing these colours you may produce several others, wherewith you may paint or stain what figures you please; and the more you repeat laying on this colour, the deeper they will penetrate into the stone, and the stronger they will represent themselves thereon. After you have finished your staining, you may polish it like plain white marble, and then you will have the colours appear in their full lustre.

Marble may also be stained with colours which have been drawn from vegetables, with spirits, sal-armoniac, or urine; but although they penetrate a good way into the marble, they will, on account of their volatile nature, be of no long duration: the red colour in this process is made of dragon's-blood,

tempered with urine of horses, hogs, or dogs; the blue is treated in the same manner, for which they use blue verditer: the purple colour is drawn from cochineal mixed with any of the said urine; some, instead of urine, use spirit of wine.

To imitate marble.

TAKE plaister of Paris, quick-lime, salt, ox-blood, stones of different colours, also pieces of glass, all beat to powder, and mixed up to the consistence of a paste, with vinegar, beer, or four milk, and then lay it into tables, pillars, or what you will; let it stand so long until it is thoroughly dry; then rub it first with a pumice, and polish it with tripoli, giving it the finishing stroke with rubbing it over with leather and oil. *Or,*

WITH fine pulverised plaister of Paris, and size of parchment, make a paste, mix with it as many colours as you please, spread it with a trowel over a board, and when dry proceed as before.

To paint on wood in imitation of marble.

FIRST lay a ground (repeating it seven or eight times) with white, as you have been directed in the method of gilding on wood; then marble it with what colours you please, after you have tempered them with the white of eggs, and mixed a little saffron water therewith. If you are not used to marbling with a pencil, you may pour one sort of your colour here and there a little, upon the white prepared table, then holding and turning it shelving, the colour will disperse all over the ground in variety of veins; then with another colour proceed in the same manner, and so with as many as you think proper, and it will answer your purpose: after it is dry, you may with a pencil give it a finishing, by mending such places as are faulty; then you may lay on a varnish, and polish it in the best manner you can.

To imitate or counterfeit agat.

TAKE of clarified turpentine as much as you will, boil it in an earthen pan, with a little sweet oil, so long till the turpentine be as thick as a dough, then pour it on a mould, and let it stand in the sun for eight days; after this you may form it into what shape you please, and set it in a shade till it is quite hard and dry.

Others take the white of 18 eggs, beat well together: then they add to it 3 ounces of clear gum-arabick, 1 ounce of almond-tree gum, beat to a palpable powder, and mix it with the white of eggs, when it is well dissolved they pour it into an earthen deep plate or dish, and set it in the sun, till it is a mass of that substance that you may form or make impressions with of any thing.

Others take the white of eggs, beat them clear, take off the scum with a clean sponge, then colour it with a tincture of saffron, and pour it into a hog's bladder; boil it hard on a slow fire, hang after this the bladder in the air, when it hardens, so that you may form what you will, and set it in the shade till it has the hardness of a stone.

To imitate a jaspis.

TAKE quick-lime, mix it with the white of eggs, and roll it up in balls, this will serve for the white; for red mix along with it lake or vermilion; for blue add indigo or *Prussian* blue: for green use verdegrease, and so on.

When you have made many different sorts of coloured balls, to the consistence of a dough, then flat them with a rolling-pin, as you would do pye-crust, lay them one upon another, and with a thin knife-blade, cut it in long pieces, and mix them confusedly in a mortar together; then with a trowel spread it over a table, pilasters, &c. very smooth and even; when dry, pour boiling hot oil upon it, and spreading it all over, it will soak in; then set it in a shady place to dry.

You may, if you will, mix your quick-lime and your colours with oil at first, and then there will be no occasion to oil it afterwards.

R 4

How

How to clean alabaſter or white marble.

BEAT pumice ſtones to an impalpable powder, and mix it up with verjuice, let it ſtand thus for two hours; then dip in it a ſponge and rub the marble or alabaſter therewith; waſh it with a linen cloth and freſh water, and dry it with clean linen rags.

To ſtain alabaſter images of all ſorts of colours for this purpoſe.

TAKE quick-lime, allum, ſal-armoniac, of each 1lb. pour upon it, after you have pounded and mixt it, of ſtale urine of a boy 1lb. and ſpirit of wine 1lb. put it into a limbeck, and a good deal of the ſpirit of wine and of the urine will diſtil from it without fire; and when you perceive that it comes but low, put a ſlow fire under it to diſtil the reſt of the ſpirit from it. When done, put it up in a phial and ſtop it cloſe. This ſpirit extracts from all the drugs their natural colour, as out of farnembuck a fine red; of orlean a fine yellow; of turneſol a purple; out of cochineal a fine crimſon; of lackmoſe a fine blue; of verdegreaſe a pleaſant green; of curcumi an orange colour, &c.

To imitate marble in brimſtone.

TO do this, you muſt provide yourſelf with a flat and ſmooth piece of marble, on which make a border or wall, to encompaſs either a ſquare or oval table, which you may do either with wax or clay. When this is done, provide and have in readineſs ſeveral ſorts of colours, each ſeparately reduced to a fine powder; as for example; white lead vermilion, lake, orpiment, maſticot, ſmalt, *Pruſſian* blue, and ſuch like colours. After you are provided with them, then melt on a ſlow fire in ſeveral glazed pipkins ſome brimſtone; put in each one particular ſort of colour, and ſtir it well together; then having before oiled the marble all over within the wall, drop with one colour, quickly, ſpots upon it, of larger and leſs ſizes; then take another colour, and do as before, and ſo on, till the ſtone is covered with ſpots of all the colours you deſign to uſe: then you muſt conclude what colour the maſs or ground of your table

table is to be; if you would have it of a grey colour, then take fine sifted ashes, and mix it up with melted brimstone; or if red, with *English* red ochre; if white, with white lead; if black, with lamp black or ivory black. Your brimstone for the ground must be pretty hot, so that the drops upon the stone may unite and incorporate together, when you have poured your ground even all over, then, if you will, put a thin wainscot board upon it; this must be done whilst the brimstone is hot, making also the board hot, which must be thoroughly dry, in order to cause the brimstone to stick the better to it, and when it is cold, polish it with oil and a cloth, and it will look very beautiful.

To imitate a porphyry on a glass.

TAKE red ochre and lake, grind them with water of gum tragacanth; then sprinkle with a brush or feather, the glass all over with that colour; when dry take brown-red, or if that is too red, add some umber, or foot to it, mix it up with gum tragacanth to the consistence of a paste, and lay it on the glass, over the sprinkled colours, as thick as you please; then let it dry. If you proceed after the same manner on a polished marble, or any other stone that is flat and smooth, and lay a thick coat of the brown-red on the spots of lake, letting it dry in the shade, and then polish it, you will have a beautiful imitation of porphyry without the glass; observe to anoint the stone first with a little oil, before you sprinkle your lake, so as to come off easy when the work is done.

How to make fret-work cielings.

TAKE pebbles, pound them fine in an iron mortar, searse them through a fine hair sieve, then take of powdered lime one part, of the pebble powder two parts, and mix them together with water; then take the mixture, and lay it all over the cieling very smooth; carve then on it what you please, or lay to it some ornament with moulds which are cut in smooth wood, or cast in lead; fill the mould with the mixture, press it to the cieling, and it will stick and come clean out of the mould; let it dry; when dry, and you perceive that it is not every where of a good white, then with a clean pencil-brush and clear water strike it over, and it whitens of itself. It will in time grow as hard as stone.

PART

P A R T XI.

Plain Instructions for Limning and Colouring
PRINTS, MAPS, &c. with Water-Colours, and
Drawing in PERSPECTIVE.*Of the colours generally used in that art.*

For
White
use { 1 White Lead
2 Flake White
3 Muffel Silver

Blue { 1 Indigo
2 Blue Lake
3 Blue Verditer
4 Smalt
5 Ultramarine
6 Lotmis
7 Prussian Blue

Red { 1 Vermilion
2 Red Lead
3 Red Ochre
4 Lake
5 Carmine

Black { 1 Lamp Black
2 Ivory Black
3 Sea-Coal Black
4 Indian Ink.

Green { 1 Sap Green
2 Verdigrease
3 Terre Verde

Yellow { 1 Yellow Ochre
2 Masticot
3 Pale Masticot
4 Dutch Pink
5 Gamboge
6 Naples Yellow
7 Shell Gold

Brown { 1 Brown Ochre
2 Chimney Soot
of a Wood Fire
3 Cologne Earth
4 Umber

Out of these Colours you may temper all the rest which
your work may require.

Some

Some colours are to be washed and ground, as for instance,
 1 White lead. 2 Brown ochre. 3 Dutch pink. 4 Um-
 ber. 5 Cologne earth. 6 Ivory black.

Some are only to be washed, which are, 1 Red led. 2 Mas-
 ticot. 3 Blue bise. 4 Smalt. 5 Ultramarine. 6 Vermilion.

Others are only steep'd in fair water, as, 1 Gamboge.
 2 French yellow, to which you must add a little allum. 3 Sap
 green. 4 Blue lake, and 5 Latmus.

And others again are only ground, *viz.* 1 Flake white.
 2 Indigo. 3 Lake. 4 Distilled verdegreafe.

Grind all your colours with fair water on a hard stone, or
 on a piece of looking-glass, which fix with white pitch and
 rosin upon a flat board, having also a muller of that kind.

Of the colours (after you have ground them very fine) you
 may take as much as will serve your present occasion, and tem-
 per them in a gallipot or shell with gum-water, in which you
 have also dissolved some sugar candy. You must observe, that
 colours which are very dry, require a stronger gum-water, in
 others it must be used very sparingly.

If your colours won't stick, or the paper or print be greasy,
 mix a very little ear-wax, or a little drop of fish or ox-gall a-
 mongst your colour; you may dry your fish or ox-gall, and di-
 lute it when you have occasion for it, with a little brandy. If
 your paper or paint sinks, then with clean size and a sponge
 wipe it over, after you have fastened the edges round upon a
 board and let it dry.

You should be provided always with phials containing the fol-
 lowing liquids, which are very necessary and useful in painting
 or colouring with water-colours.

1. A phial with water in which allum has been dissolved.
 This you use in wiping over your table, parchment, or paper,
 before you begin to lay on your colours; it will cause them
 to lie smooth, and with a greater lustre.

2. A phial with lime water; you dissolve or slacken some
 quick lime in fair water, then take the water from off the set-
 tled lime, and put it up for use; this is of great use in tem-
 pering of sap-green and litmos, which colours being apt to
 turn yellow, are preserved thereby.

3. Gum-water is made of gum-arabic dissolved in fair wa-
 ter; if you add a little white sugar-candy to it, that will keep
 the colours from cracking and flying off the parchment or
 paper.

4. Ox-

4. Ox-gall, or the galls of eels, boiled up in a little water, and scum'd, then put up in a phial; this is of great use in painting of water-colours, where the parchment or paper happens to be greasy, by only touching the point of your pencil to wet it therewith, and to temper it with your colour.

5. White wine vinegar; this is of use in grinding of distill'd verdegrease, as preserving that colour from changing upon the yellow.

6. A little phial of spirits of harts-horn, a little drop whereof mixt among the carmine adds to the beauty thereof.

You must chuse pencils of several sizes, agreeable to the work you are to use them for; as for laying on a ground, a sky or clouds, chuse a larger size than those that you use for drapery, trees, &c. wherein you must follow your own reason: those pencils of which the hairs, after you have wetted them between your lips, and turned them upon your hand, keep close together, are the best.

To paint or colour a clear sky.

TAKE clear blue verditer, mix'd with a little white; with this begin at the top of your landscape or picture, and having laid on the blue for some space, break it with a little lake or purple, working it with a clean pencil, one colour imperceptibly into another; apply more white and masticot, in order to make it fainter and fainter towards the horizon, working all the while the colours imperceptibly one into another from the horizon to the blue sky; after which you may lay some stronger strokes of purple over the light, so as to make them appear like clouds at a distance.

For fiery red sky, use red lead and a little white instead of the purple streaks or clouds, working them according to art imperceptibly one into another.

Clouds you are to lay on with white, and black, sometimes mix a little purple therewith; but the best and surest direction you can have is from nature herself.

To

To lay a ground for walls of chambers, halls, &c.

YOU must use for a common wall, which is of a reddish hue, brown, red, and white, and temper your colour according as it is old or new; shade it with brown-red, only mixed with a little bistre or foot.

Other walls lay on with black and white, and shade it with the same colours; sometimes mix a little purple with it, and then you shade it with black and lake.

For wainscoting, that is embellished with carved mouldings and figures, you must use one colour for both the plain and the carved work, shading and heightening it with judgment and care.

To paint a fore ground, in imitation of sand or clay, lay on the darker parts with brown ochre; to what is in their distance, add a little white, and so on in proportion; shading it with brown ochre, and the strong shades with foot.

Of carnation or flesh-colour.

IN a carnation or flesh-colour, use for young women and children flake white, burnt ochre, and a little vermilion: some add a little lake, but that must be but sparingly: having laid on the colour for the carnation, you shade the lips, cheeks, chin, knees, and toes, with fine lake and vermilion, and the naked parts, with sea-coal and a little lake, or brown red, or with brown ochre and lake, or else with indian ink or lake; for a brownish complexion, mix a little brown ochre among the carnation colour.

Some artists lay the dead colouring of the carnation for young women on with white, then shade it with paper black, and bring in the carnation colour where it is required. The

Paper-black.

Is made in the following manner; Take the paper in which the leaves of gold have lain, burn them quick one after another and let them drop into a basin of clean water; then take them
out

out and grind them on a stone to a fine paste, form it into little tents, and let it dry; when you use it temper it with gum water as you see meet.

For antient people use vermilion, brown ochre and white, shade it with bistre and lake.

A dead corpse of a young person paint with flake white, brown ochre and a little indigo, or sea-coal, and shade it with bistre or sea-coal.

For an old dead corpse leave out the indigo, but shade it as before.

For dead bones, take white lead mixed with a little bistre or chimney foot; with which you shade it and heighten it with white lead.

For the hair of young women and children lay them with light ochre, shade them with deep ochre, and heighten them with masticot and white.

Grey hairs lay on with black and white, shade them with black and heighten them with white; and thus proceed in painting any other coloured hair.

Drops of blood lay on with red lead, shade it behind where the light falls with carmine and lake.

Trees are laid on, some white, black, and bistre, shaded with brown ochre, and heightened with the same colour, with more white in it. Those that stand at a distance, are laid on with indigo blue, brown ochre and white, and shaded with indigo and brown ochre. Those that are further distant lay on faint, and shadow them but slightly; which order you must observe in colouring of ships, houses and other buildings.

In thatched houses paint the thatch or straw, when new, with *Dutch* pink, and shade it with brown ochre, and to heighten the straw use masticot and white. Old straw lay on with brown ochre, sometimes mixed with black and white; heighten the straw with brown ochre, and white.

In colouring cities, castles, or ruins, you must observe nature, for no rules can be well given; however to give a little light to a young practitioner, it must be observed that those houses which lie nearest the fore-ground are coloured with vermilion, white, and a little brown ochre; shading it with that and some bistre; the heightenings are done with vermilion and more white.

Houses

Houses further distant, are laid on with lake and a little blue and white, shaded with blue and lake, and heightened with adding more white.

Such buildings as lie still further, are laid on with a faint purple and a little blue, shaded softly with blue and heightened with white; and the further they are off, the fainter and flighter must be your colour.

Flames and smoak, are laid on with a pale yellow; shade the smoak with paper black, or foot; the flames shade with red-lead or vermilion, and heighten them with Naples yellow.

In colouring of rocks, hills, &c. that are at a great distance, observe the same rule. Such as lie nearer the fore-ground, you are to imitate according to nature. Trees that are upon the fore-ground, you paint with several sorts of greens, the better to distinguish one from the other; such as are on distant hills, must be done with the same colour as the hills.

How to paint or colour cattle.

HORSES of chefnut colour you are to lay on with brown-red, shaded with brown, red and black, and heighten it with brown, red, white and yellow; the manes and tails of horses you may make white, as also the lower part of their feet.

You are to lay one of an ash-colour on with black and white, shade it with a bluish black, and heighten it with white.

Lay on a black horse with all black, shade it with a deep black, and heighten it with black and white.

Lay a white horse on with white-lead, just tainted or broke with a little red; shade it with black and white, and heighten it with pure white.

Spotted horses must be done according as nature directs; and by these directions you will govern yourself in painting or colouring any other sort of cattle.

Lay sheep on with white, broke with a little bistre; use in the shadows a little black.

Lay on hogs or pigs with brown ochre and yellow ochre, and shade it with bistre.

A bear is laid on with brown ochre, black and brown red, shaded with bistre and black, and heightened with brown ochre and white

A leopard

A leopard is laid on with yellow ochre, and shaded with bister; the spots are laid on with bister and black; the mouth with black and white.

An afs is commonly of a grizly colour, and laid on with black and white, broke with a little ochre.

An elephant is laid on with black and white and a little bister.

A monkey is laid on with *Dutch* pink, bister and black; the hair is heightened with masticot, white and a little bister; the paws must be shaded off with black and brown-red, with a little white.

A hart is laid on with brown ochre and *English* red and shaded on the back, and where it is requisite, with bister and brown-red; a streak of white must be below the neck, as also the belly and breast of a white colour.

A hare is laid on with brown ochre; which loses itself by degrees into white under the belly; the back is shaded with bister, and the hair is heightened with ochre and white.

A rabbit is laid on with white, black and bister; the belly is white; these creatures are of various colours, which may be imitated after nature.

Of birds.

A Falcon is laid on with brown ochre, black and white, shaded with a pale black; the feathers must be displayed and shaded with black, the breast is white, the legs are laid on with yellow and shaded with brown ochre and bister.

A turkey cock or hen, is laid on with black and white, and shaded with black, working the colours lighter and lighter towards the belly, which must be all white; the legs are laid on with indigo and white, and shaded with blue; when they are irritated, the substance about their bill must be laid on with vermilion and lake, deepening it with stronger lake; otherwise, when they are calm, that part is a little upon the purple.

A swan is laid on with white, with a little bister, and heightened, where the feathers seem to rise, with pure white; the feet are blackish and the bill red, with a black rising at the upper end.

Pigeons,

Pigeons, drakes, hens, &c. are of so many various colours, that there would be no end to give proper lessons for every one, and thus it is with many other birds, which an artist ought to copy after nature.

Of Fruit.

APPLS are laid on with fine masticot mix'd with a little verdegrease, or a little white, french-berry yellow and verdegrease, shade it with brown-ochre and verdegrease, or lake; heighten it with masticot and white and the strongest light with white alone; but you must regulate yourself according to the colour of the apples as well as pears.

Cherries are laid on with vermilion and lake, shaded with pure lake, and heightened with vermilion, or vermilion and a little white.

White-heart cherries, are laid on in the middle with vermilion, lake and white, working it to a yellow towards the stalk, and with lake towards the top.

Morello's are laid on with lake and a little black, shadow'd with black, and heightened with vermilion, lake and black: this must be intermix'd, that the colours may seem all of one piece.

Mulberries are laid on with lake and bistre, shadow'd with black and heightened with vermilion; on the highest lights give little dots with lake and white.

Strawberries are laid on with a yellowish white, then shaded with lake and vermilion; and heighten the knobs with white and vermilion.

Grapes, the black ones are laid on with purple, shaded with blue verditer and indigo, heightened with white.

The white grapes are laid on with pale verdegrease, a little masticot and white; the blue bloom is very gently, with a blunt pencil touch'd with blue verditer.

Peaches and apricocks are laid on with white masticot, or french-berry yellow and white, shaded with red-ochre and yellow; if there must be a bloom upon them, do it with lake, and heighten it with white as you do the grapes; some are of a greener colour than others, wherein you are to copy nature as it lies before you.

S

Radishes

Radishes and turnips, are laid on with white, shaded with indian-ink, and at the top with lake; working it down faint into white towards the bottom. The top is laid on with verdegrease and sap-green, shaded with sap-green and indigo, and heightened with masticot.

Carrots are laid on with yellow-ochre, and if they are of a high colour it is mixed with red-lead; they are shaded with brown-ochre, yellow-ochre and bister, and heightened with masticot. For the rest I direct the practitioner to nature.

Of Flowers.

ROSE S are laid on with a pale carmine and white, shadowed with carmine and less white, and the deepest with carmine by itself; make the heart always darker than the rest. The seed in full blown roses is yellow.

Tulips are of various kinds, colours and shapes; it is impossible to give certain rules for colouring them.

Some are done with lake and carmine on white, mixed together; others with purple, laid on with ultramarine, carmine and lake; sometimes bluer and sometimes redder; these colours must be streaked according to nature. Those of one colour, as yellow, red, &c. are laid on with such colours, and if there appear any streaks you must make your colour either lighter or darker, as nature directs.

Emonies are of several sorts, some are laid on with lake and white, and finished with the same. Others with vermilion, and shadowed with that colour, carmine and lake. Yellow ones are laid on with masticot, shadowed with that and vermilion, sometimes with brown lake.

Red lillies are laid on with red-lead, shaded with vermilion, and carmine.

The peony is laid on with lake and white, and shaded with the same colour and less white.

Yellow cowslips are laid on with masticot, and shaded with gamboge and umber. Purple ones are laid on with ultramarine, carmine and white, and shaded with less white.

Carnations and pinks are managed like emonies and tulips.

Some pinks are of a pale flesh-colour, streaked with another that's a little higher; this is done with vermilion, lake and white, and streaked without white.

The

The blue hyacinth is laid on with ultramarine and white, and shaded with less white.

The red or grideline, is laid on with lake and white, and a little ultramarine ; and finish'd with less white.

The white fort, is laid on with white, and shadow'd with black and white.

The crocus are of two sorts, *viz.* yellow and purple. The yellow is laid on with masticot, and shaded with gall-stone or gamboge ; after which upon each leaf on the outside are made three separate streaks with bister and lake. The purple ones are laid on with carmine, ultramarine and white, and finish'd with less white ; the streaks must be very dark on the outside of the leaves. The seed of both is yellow.

Of Metals.

GOLD is laid on with red lead, saffron, and yellow ochre, shadow'd with lake and bister ; in the deepest places with bister, lake and black, then heighten'd with shell-gold.

Silver is laid on with white, shadow'd with black and blue, and heighten'd with shell-silver.

Tin or pewter is done the same way, only it is laid on with white, mixt with a little indigo.

Iron is done like tin.

Brass is done in the same manner as gold, only the shades must not be so strong.

Copper is laid on with brown-red and white, shadow'd with brown-red, lake, and bister, heighten'd with brown-red and white.

These directions will be sufficient to guide young practitioners to nature, which is the best school they can go to.

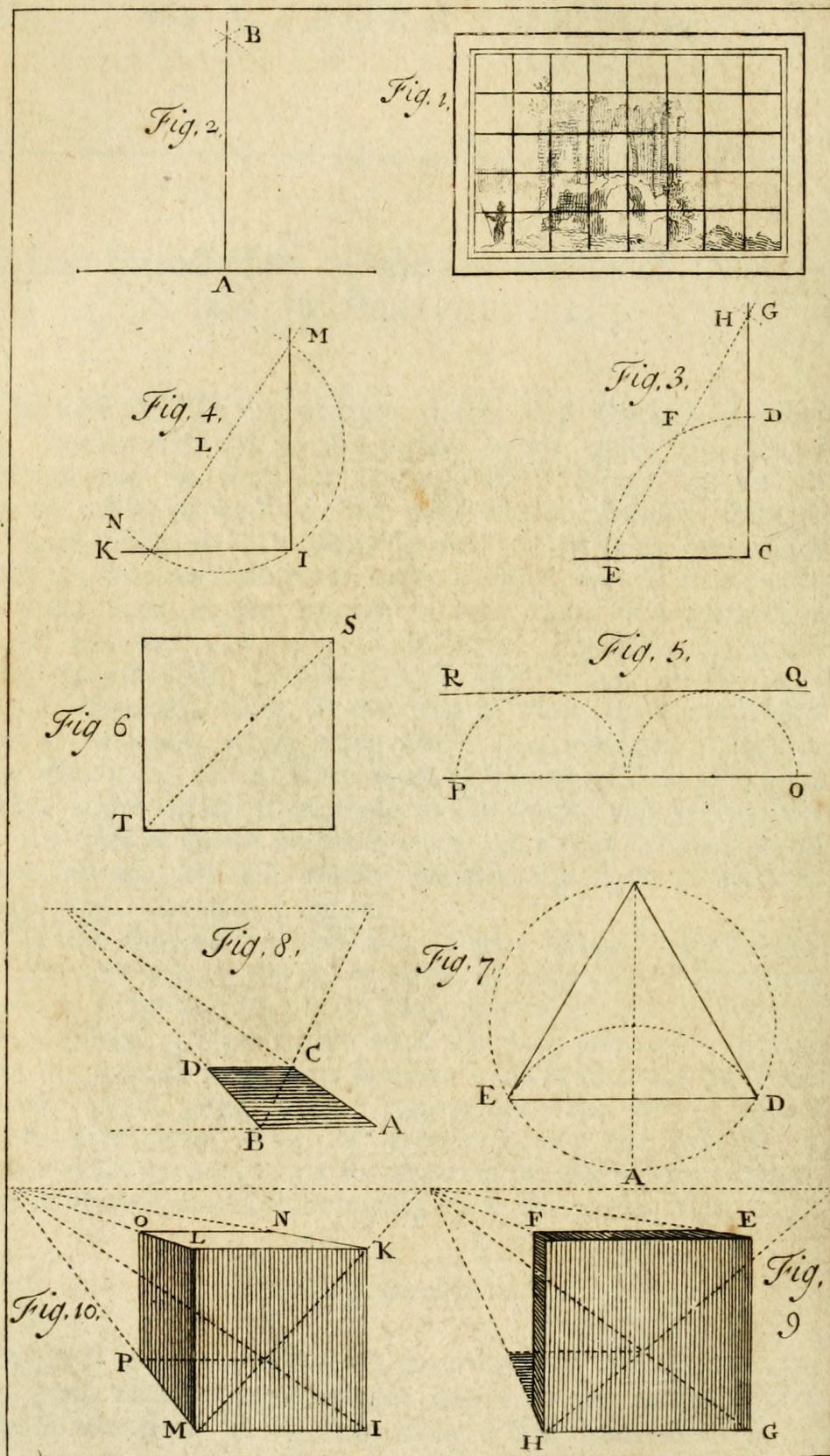
A short Introduction to the Knowledge of DRAWING in PERSPECTIVE.

PERSPECTIVE represents things seen through a transparent medium, as air, water, clouds, glafs, &c. and as nothing can be seen but through those things, all we do see is call'd perspective: we will suppose looking through a square frame or a window in a room, at some convenient distance, into an open field, garden, street, &c. all that comes into our sight in the compass of that frame is a perspective view, and that view, draw'd in its due proportion, as it appears to our sight, is call'd a perspective picture or drawing: this is frequently done, by the help of frames squar'd out with cord or cat-guts, which being plac'd in a window, or fix'd in any other place, the artist has as many squares rul'd on his paper, either larger or less than those in the frame, and having fix'd in the table a round spectacle frame on a stick before him, to look through, he will thereby preserve the sight of what he is copying. *See plate I. fig. 1.*

This is done without the rules of art; but as I here propose to give novices in the art of drawing perspective a little light into it, as far as it may be of some service to them in drawing or painting, I shall begin with the first principles thereof, and so proceed in an easy familiar method to make the study thereof plain, pleasant, and expeditious; but first of all we must learn some terms of geometry, and the practice of them as far as is necessary for drawing in perspective, without which we can make but little progress in the pursuit of it.

To elevate perpendicular lines.

DRAW a line, which with your compass you divide in A, then from the ends of this line make the arches, which divide themselves in B, then draw a line from A to B. If the



the perpendicular is to reach below the line given, you proceed in the same manner as above, *fig. 2.*

II. To elevate a perpendicular from the end of a line, may be done as the above, but where room is wanting you must place one leg of the compass at the point C, and with the other make the large portion of the circle D E, then set the compass open to the point E, and with it divide the circle in F, then take half thereof, and add it to the former, which will give you the right angle to draw your perpendicular. Or you may with the same opening of the compass, without seeking the half measure, make from F and an arch G H, then laying the ruler at the points E F, you draw a line which shall divide that arch, there you elevate a line from C to G H, *fig. 3.* Or,

Take a point at pleasure over the line I K as L, then from that point make a circle which touches the point I, and will divide the line at M, then draw from M by the point L, to the circumference of the circle N, a line, and M I will be the perpendicular. *fig. 4.*

III. To draw a parallel, you must do it over half rounds, which they must touch as O P, and are parallel to Q R, *fig. 5.*

IV. The *Horizontal* line is no other but a parallel to the base, of which more hereafter.

V. The *Diagonal* line is drawn from one angle to another, as S. T. *fig. 6.*

VI. A *Triangle* is made by setting half the diameter at the point A, and describe the arch D E and draw a line D E, which will give the side of the triangle. See *fig. 7.*

VII. *Ichnography* is the dimension of a platform or plane, upon which any thing is to be raised, as A B C D is the *Ichnography* or plane of a square body. See *fig. 8.*

VIII. *Orthography* describes or represents the face or fore part of the object, as of a building, or a body of any thing op-

posite to one's eye, so as E F G H, which is the *Orthography* of the forepart or front of a cube, or a building, *fig. 9.*

IX. *Scenography* represents the object wholly elevated, with all its dimensions of the front, sides and top which may be seen; as I K L M N O P is a perfect cube. *See fig. 10.*

Of the visual rays.

THE visual ray is that from the object to the center of the eye; it is the strongest of all others; it is this which divides the horizontal line and gives the point of sight; if the object be a point then there is but one ray visual, which is call'd central, *a b, fig. 1. pl. II.* if the object be a right line, as *a b*, the visual rays make a triangle whereof the line *a b* is the base, and the two lines, *c d*, the rays on the outside, which come from the eye *e*, and make the triangle *e, a, b, fig. 2.* If the object is a square superface the visual rays will make a pyramid, as *fig. 3 and 4.* of which *a b* is the central and strongest.

Of the horizon.

THE horizon in perspective is a line, which gives the height of our eye, and bears always the points of sight and distance; or rather, a line which separates the heaven from the earth, and which limits the sight; for one cannot see any thing above the horizon, which surpasses not the height of the eye: thus a tree or mountain may have its top above the horizon, but the foot thereof is a good deal below it, as for example, A B are two pillars below the horizon, because the eye is elevated. In the 2d they are equal with the horizon, because the eye is with them at an equal height: in the 3d they are much above the horizon, because the eye is lower than they. Thus, according to different stations of taking the horizon, the subject before us will be either higher or lower than the horizontal line. *See fig. 4, 5, 6, plate III.*

Of

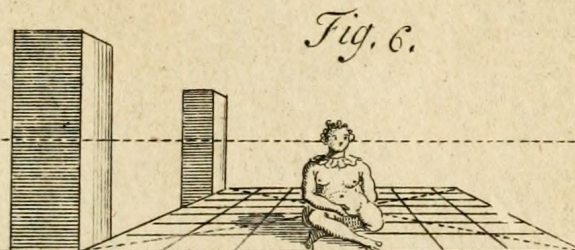
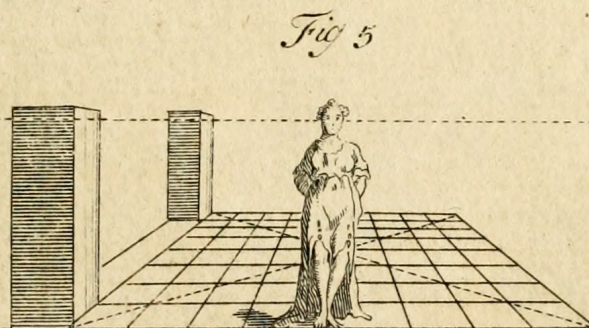
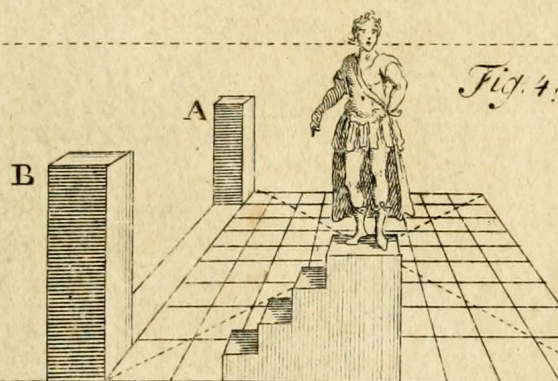
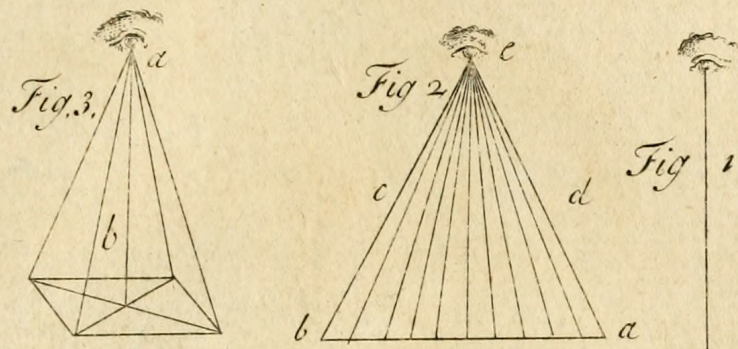


Fig 7

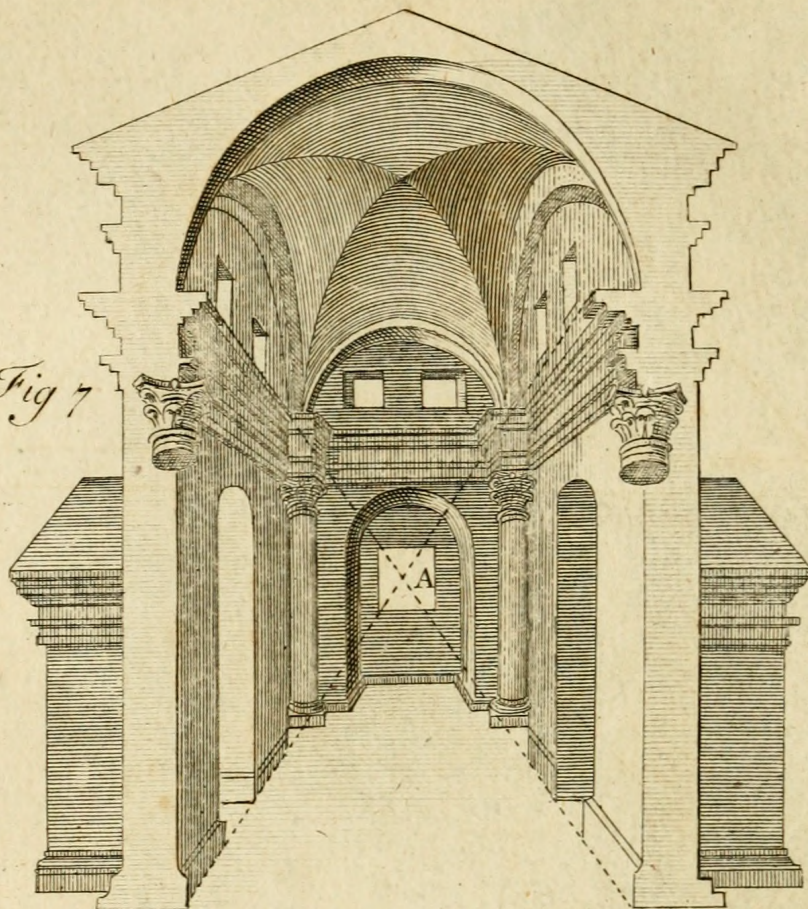
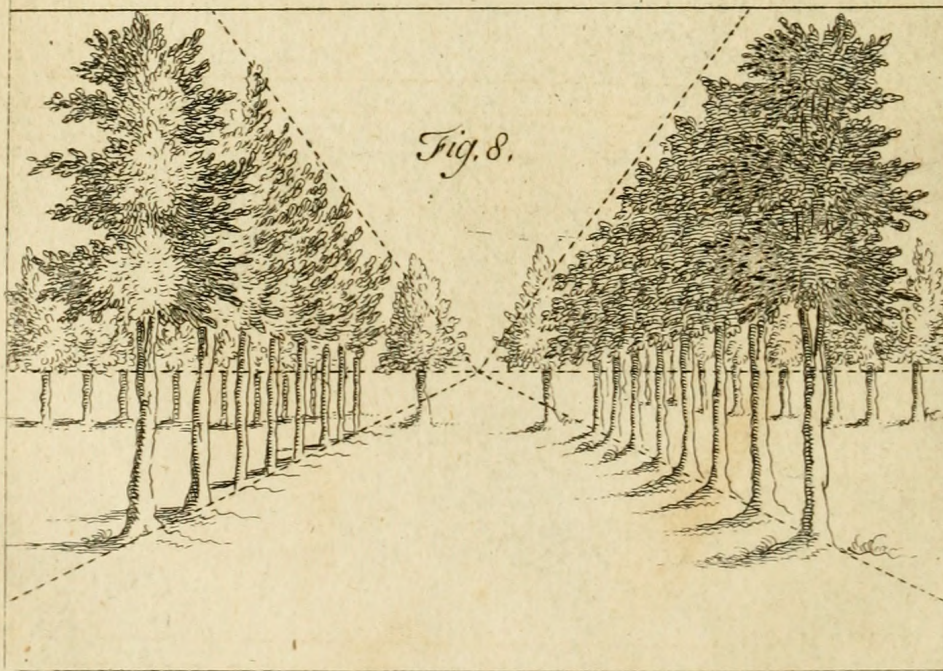
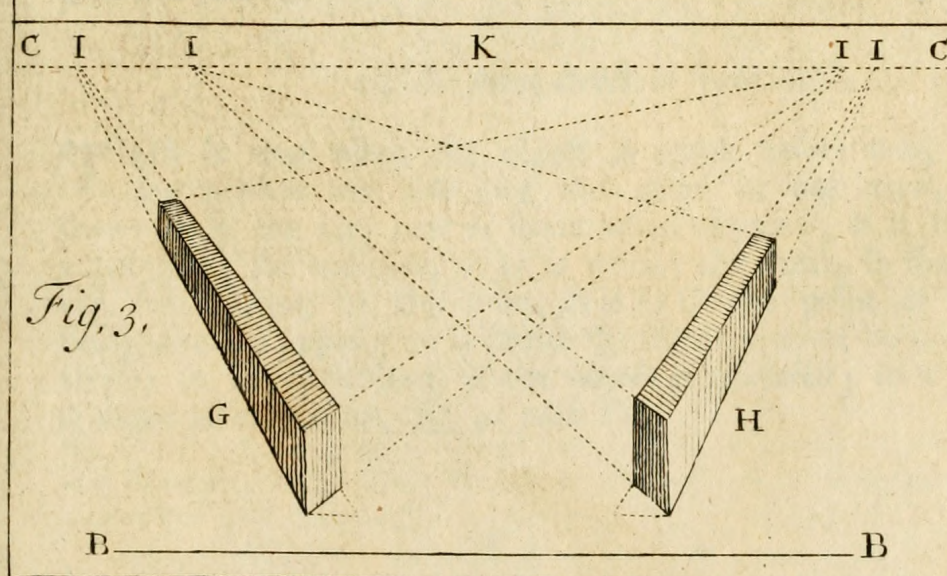
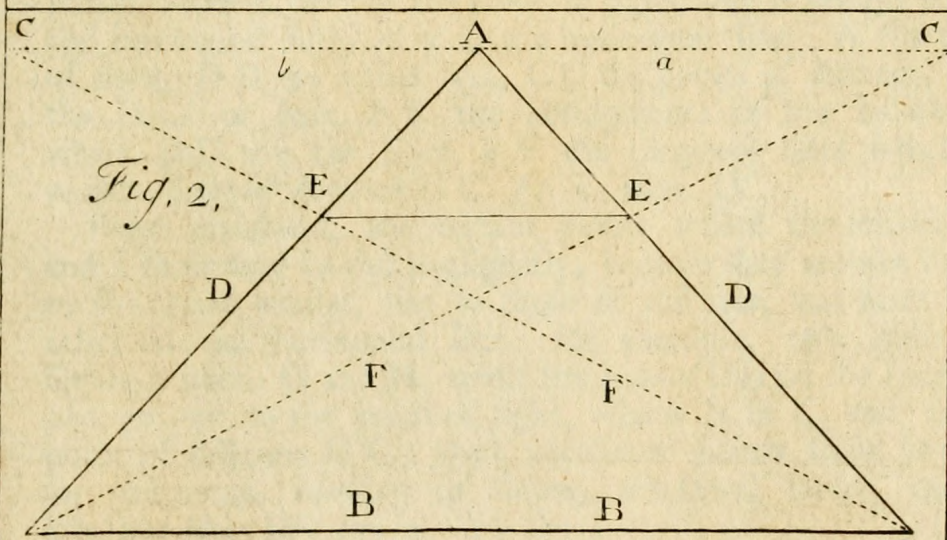
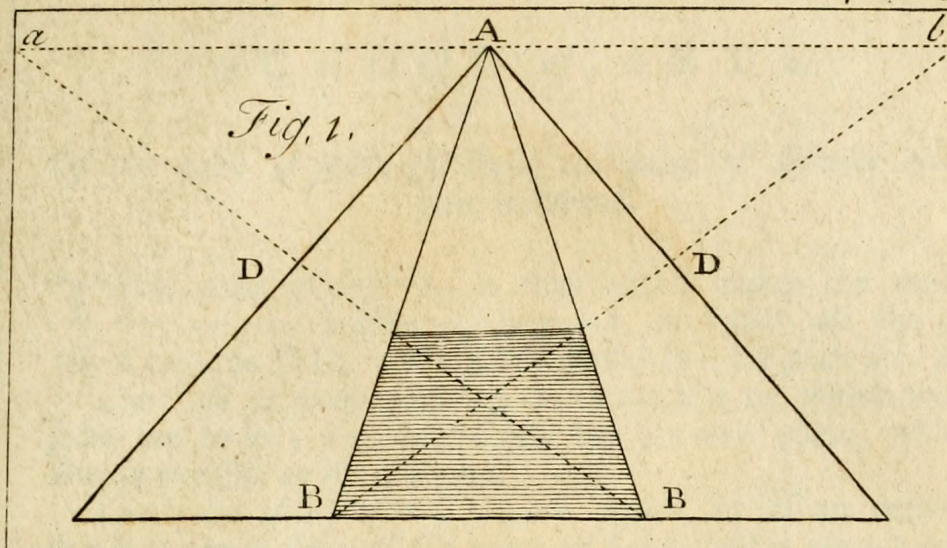


Fig. 8.





Of the point of sight, the base, the point of distance and the point accidental.

THE point of sight A, is that which makes the central ray on the horizontal line *a b*, to which all the other visual rays, as DD, are to join themselves: See plate IV. fig. 1.

The base or plane BB, fig. 2, is the line on which the objects are to be; for every object has its own plane, which is always parallel to the horizon.

The point of distance CC, are points set of an equal distance on each side of the point of sight, and is always within the horizontal line, as *a b*, the horizontal line: A the point of sight, DD the visual rays, CC the points of distance, BB, the plane or base, EE the abridgments of the square, of which DD are the sides, FF the diagonal lines which go to the points of distance CC. fig. 2. plate. IV.

Points accidental, are certain points where the objects do end; these may be cast negligently, because they are not drawn to the point ocular, not to those of distance, but meet each other in the horizontal line; for example, two pieces of square timber, G and H, make the points IIII on the horizon, and go not to the point of sight, which is in K, nor to the point of distance CC; these accidental points serve likewise for casements, opening of doors, windows, tables, chairs, &c. See plate IV. fig. 3.

Of the point direct or front.

THIS is that when the object is whole before you, having neither one side nor the other in our view, but shews only the fore part or front when elevated; if it be not a polygon; for example, AD is wholly the front, so that one can see nothing of the sides, ABC the point of sight being directly opposite to it causes the diminution of both sides: this is to be understood if the object is elevated; in a plane it shews all as you see, fig. 4. plate IV.

The oblique point of sight,

IS when the object is seen sideways, which we see with the corner of the eye; the mean while the eye being always opposite the point of sight, for example, the point of sight being fix'd in F, and the visual rays drawn, as usual to that point, the object will appear athwart, *fig. 8. plate. IV.*

Of the diagonals and their sections.

A Geometrical plane, where the lines are perpendicular and parallel to the base, are always in perspective to be drawn from the base to the point of sight; for instance: suppose one gives a shorter or longer line for the perspective than what is in the plane, as for instance, the long line A B which must have the same number of divisions as that of the plane C: from all which divisions you draw lines to the point of sight D, the diagonals F F are drawn for the dimensions of the squares, at the points of distance E E, as figure 2 plainly explains it: D the point of sight: F F the diagonal lines: A B the base: E E the points of distance wherever the diagonal lines cut the rays which are drawn from the base to the point of sight, there is the abridgment of the square, as you plainly see G G, *fig. 2. plate V.*

The diagonal line being drawn from each side the plane, either nearer or further from the point of sight, makes the abridgment either deeper or brings it closer,

Deep sinking in drawing of perspective.

THIS is done by means of drawing from each side of the base H H to the point of sight I, and likewise from the same sides to the point of distance K K, and where the latter divide the former as in L L that is the first abridgment: then drawing from L L to the points of distance, you will at M M find the 2d distance, and so on, *see fig. 3 and 4. plate V.* If the abridgment is to be oblique, you mark the point of sight as has been taught before in *fig. 8. plate I.* Thus you may draw any plane or pavement, garden plats, &c. as for example, *fig. 2. plate*

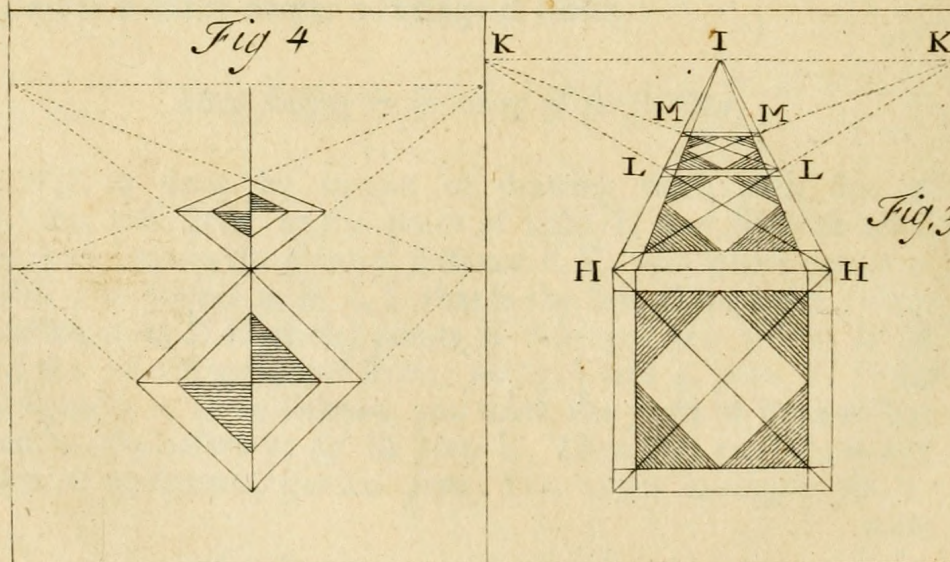
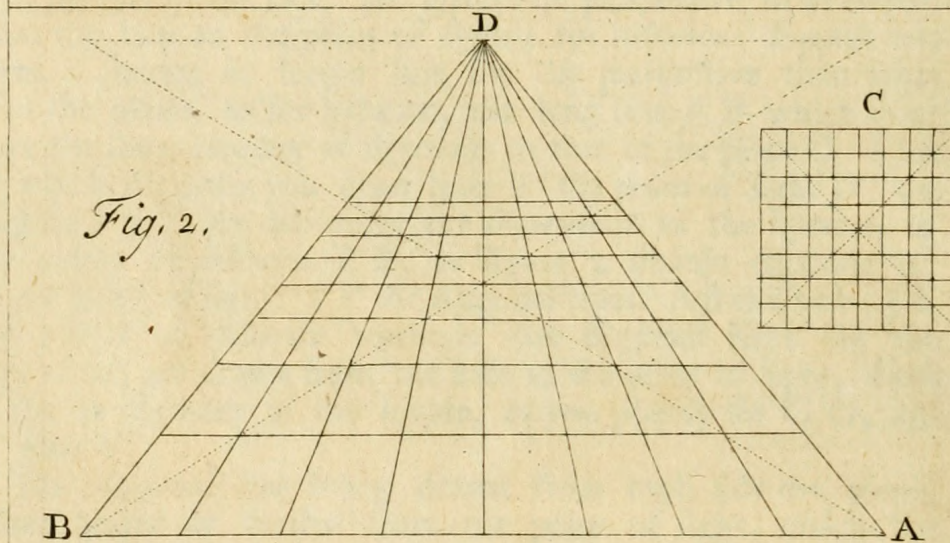
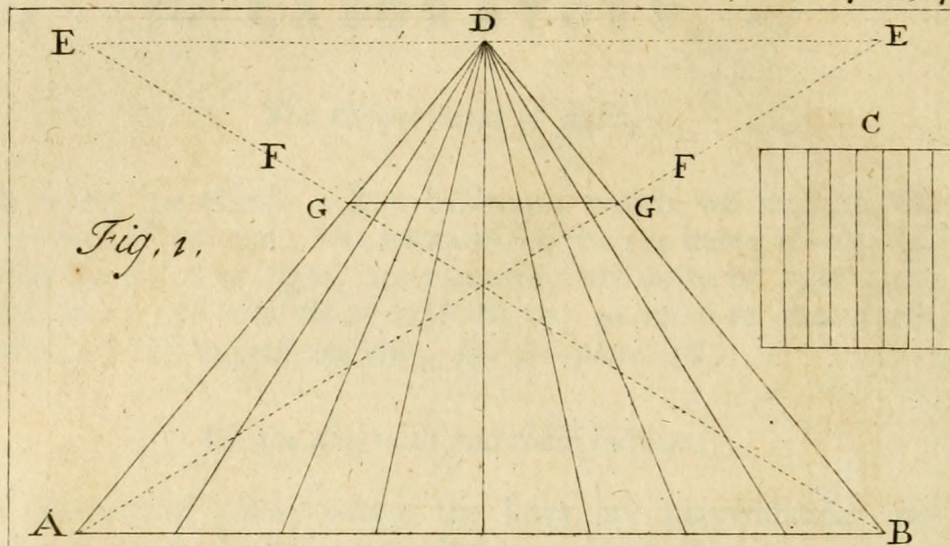


Fig. 1.

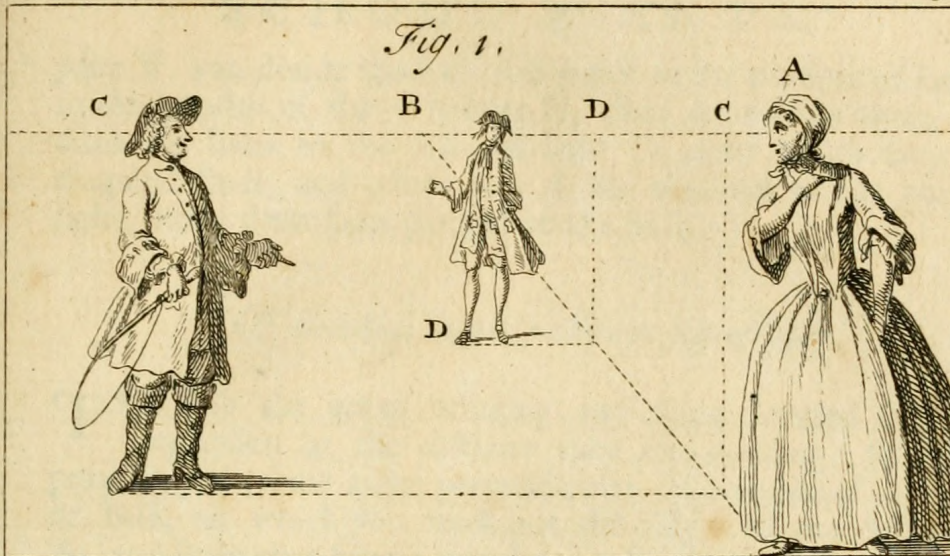


Fig. 2.

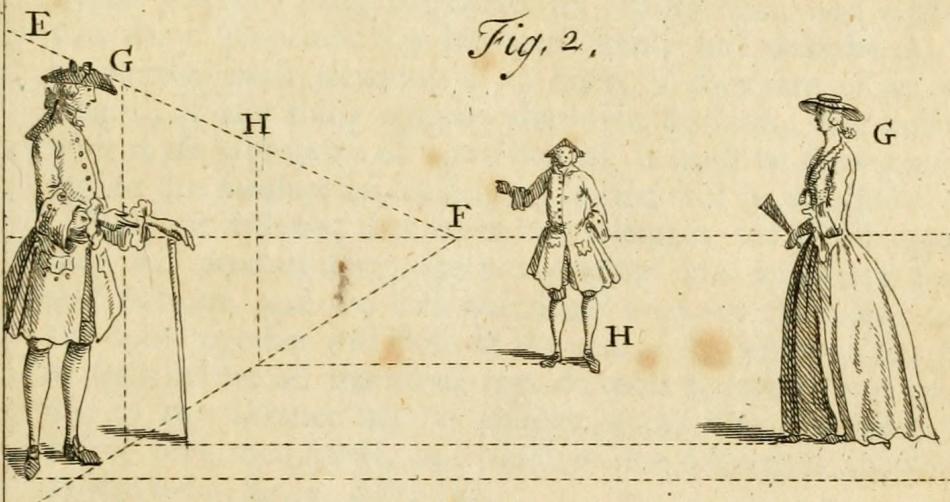


Fig. 3.

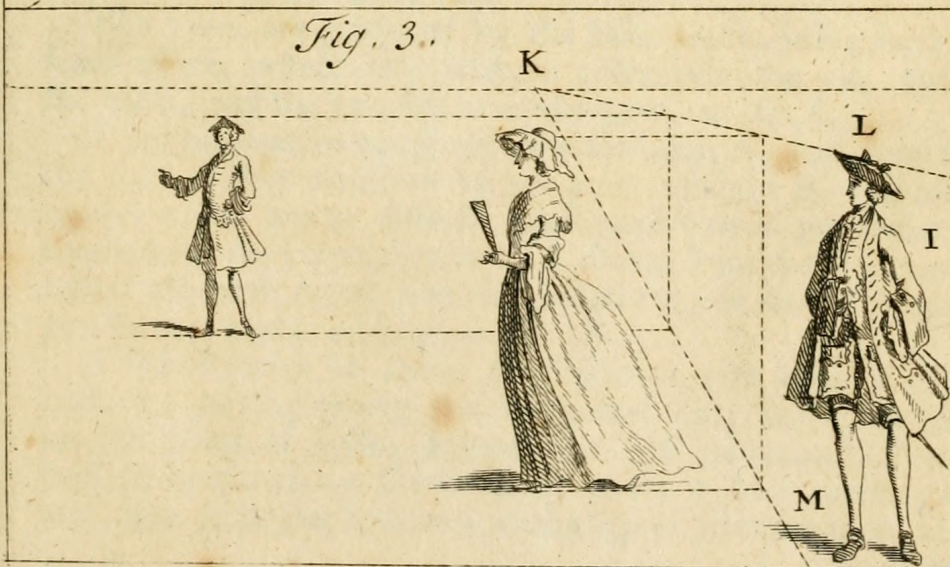


plate V. you divide the base AB equal to the number of squares in the breadth of the pavement C, then draw from these divisions the lines to the point of sight D, after which draw the diagonal lines, and where they divide the lines to the point of sight, there draw lines parallel to the base.

Of elevation in perspective or scenography.

THIS is the art of bringing any thing elevated to a true proportion at the distance they are standing: for which purpose you draw a line perpendicular on one side of the plane or base, on which you mark out the height of the first object A, and from that height you draw a line to the point of sight, which you may place any where on the horizon, and whatever you draw perpendicular between them, will describe the true proportion each elevation is to have, if they are of an equal height; if any thing appears above the horizon, that interferes with those elevations of equal height, it must be drawn according to the measure of its height, as you will be directed.

Hence it follows, that when two triangles are join'd together they will produce four, the two original ones will serve for top and bottom, and the two occasional ones for the sides: for all the four together will close at the centre A, which is the point of sight where all the visual rays do meet together, and according to the distance of the objects, those above a base, those below raise themselves, and those of the sides close themselves, as you see in *fig. 7. plate III.*

The trees are produced by the same cause, bring forth the same effect, where one triangle comprizes the air, another the earth, and the two side-ones the trees, as *fig. 8.*

If the horizon be equal with the elevation A, you draw from the foot of that elevation to the point of sight B, and all the figures which are at distance must receive their proportionable height from the perpendicular C I drawn from the horizon between the first figure and the visual ray, or line of sight, as you have it explained in *plate VI. fig. 1.*

If the elevation be above the horizon, you proceed in this manner: having drawn the horizontal line, you mark thereon the point of sight; suppose the first elevation DE to be half its height above the horizon, or let it be a quarter; then you draw from the bottom and the top of that elevation to the point

point of sight F, and between these lines you draw perpendiculars for the elevation of the figures G H which are at some distance. See *fig. 2.*

When the horizon is high, we must from the first figure I draw its height to any place of the horizon which is here to the point K, all the heights of the other figures must be done between the triangle K L M, which will determine their height at their respective distances, as is plainly shewn in *fig. 3 plate VI.*

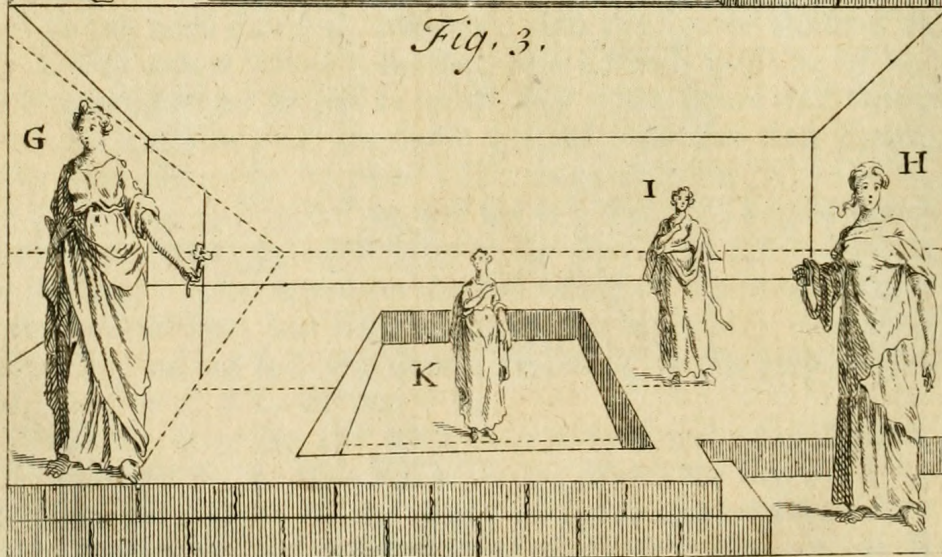
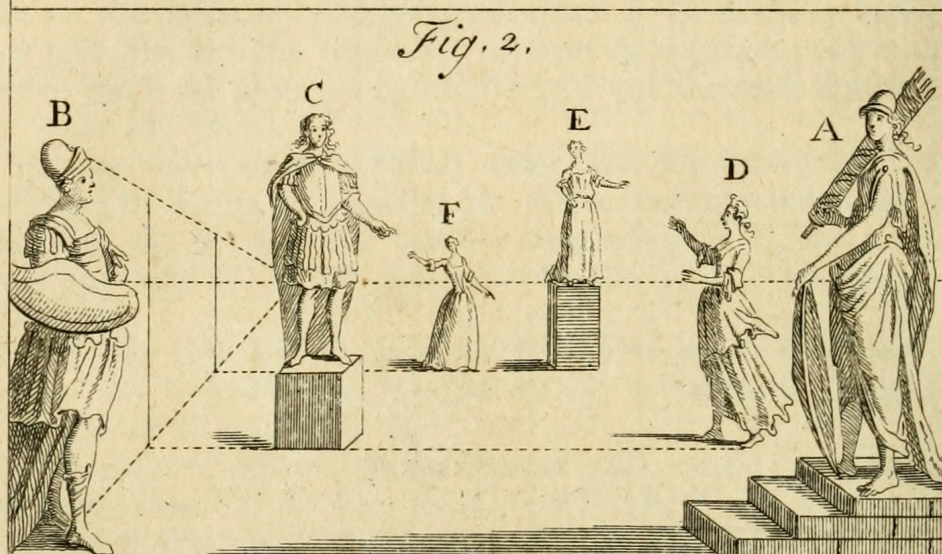
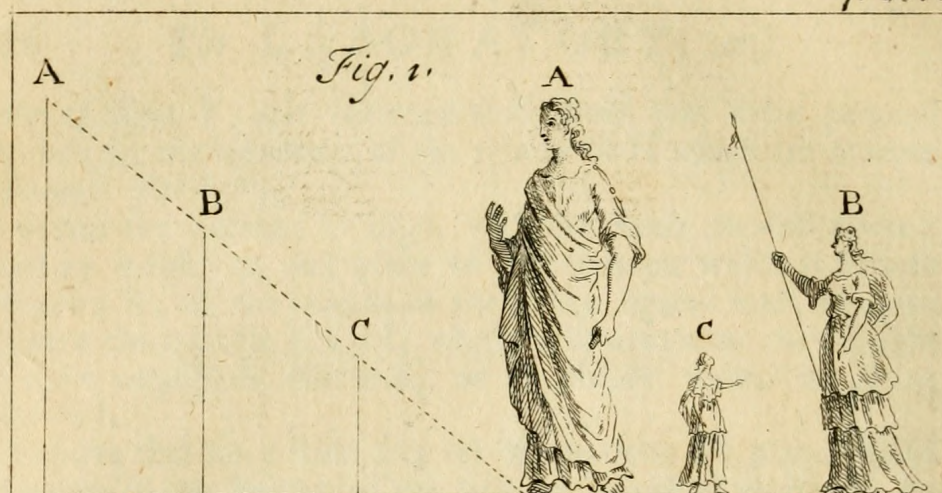
Figures that have their feet on the horizon are proportioned according to the height of the first or principal figure A, by drawing a line from the head, or a measure of its height to any part of the horizon, the perpendiculars B C between both, will give the heights required; painters or engravers will take care to make the principal figure strongest and the most finished. See *plate IV. fig. 1.*

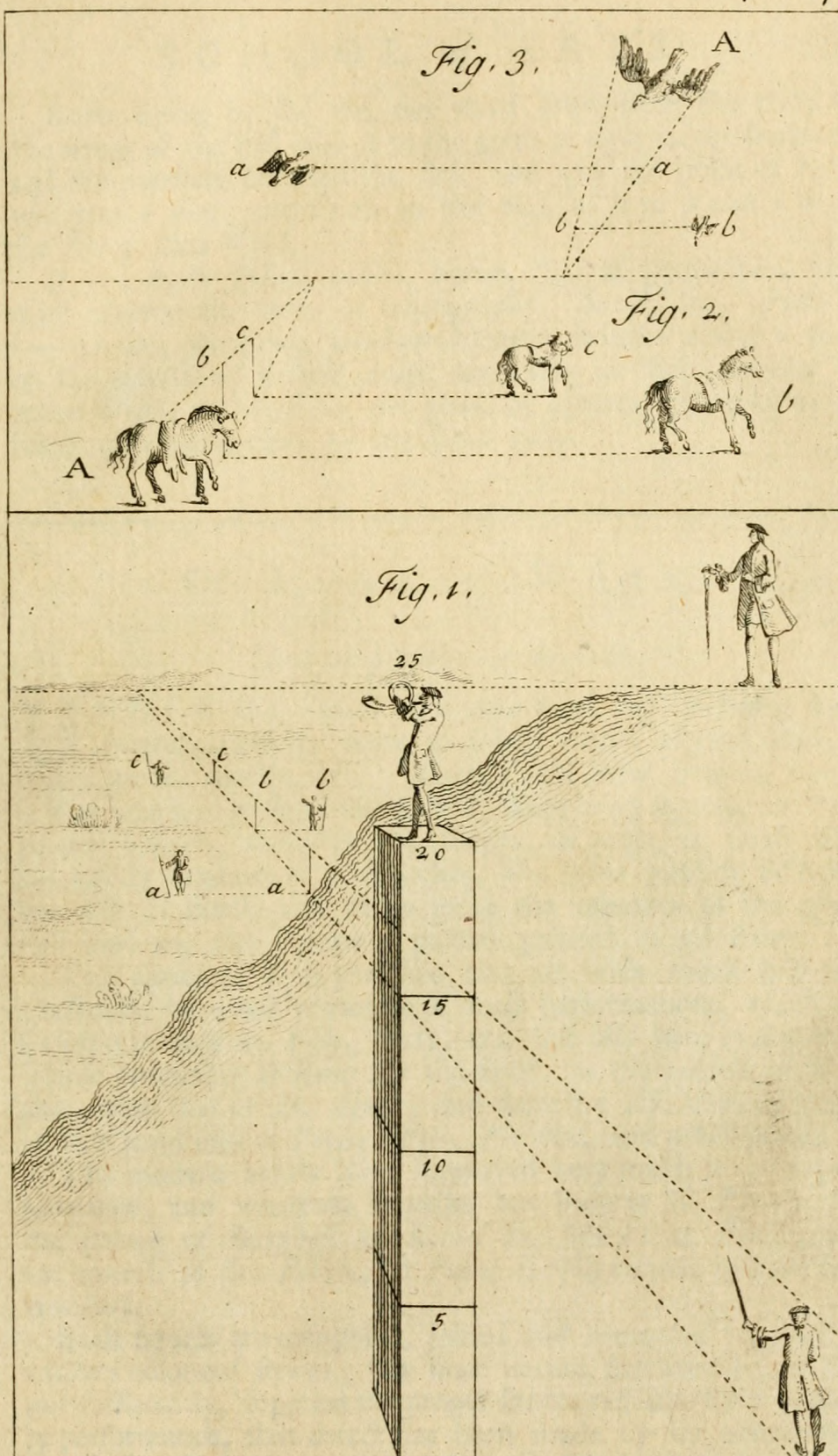
Figures raised upon pedestals must have the same height as tho' they stood upon the plane, in which you proceed as delineated in *fig. 2.* where A has the same height as B, and C is equal in height to D, and E is equal to that of F. See *fig. 2. plate VII.*

The same rule is to be observed in figures which stand lower than the base or plane, as you see *fig. 3.* where G is equal in height to H and I to K.

The height of figures seen far beyond a hill, or any other eminence, are found by drawing the natural height of a man, horse, &c. from the foot of the mountain to the point of sight, and proceed as has been directed, observing that the figures elevated on the hill or tower where you first figure stands must be of the same dimension in height as must any other figure that stands upon an eminence on the same ground with the first figure, as for example in *fig. 1. plate VIII.* Supposing the hill to be 25 feet high; the first figure we will say is 5 feet, the second figure standing 20 feet high, reaches up to the top of the hill and meets the horizon. The figure on the hill being of the same height as the two former, has his feet upon the horizon. The little figures beyond the hill are drawn according to the perpendiculars, as *a* to *a*, *b* to *b*, and *c* to *c*.

Beasts are done by the same rule as men and other figures, as for example *fig. 2. plate VIII.* having drawn the first horse A, and from his height to the point of sight, the perpendiculars will be marks for the proportion of those at a distance, as B to *b*, and C to *c*,
Birds





Birds flying in the air, one must draw from the ends of the wings of the first bird *A* to the point of sight on the horizon, and the parallels between the first bird and the point of sight will give a due proportion to the rest, as *a* to *a* and *b* to *b*. See fig. 3. plate VIII.

If you draw chairs, tables, boxes, &c. in perspective, you must observe the rules of scenography. See fig. 10. Plate I. — Doors, windows, window-shutters describe either a part or the whole of a semi-circle, according as their opening is more or less, which from the plane of squares, you may easily bring into perspective by the same rules.

OF MOSAIC WORK.

How to perform it artfully.

UNDER the name of mosaic-work are included such performances as relate to inlaid work; as tablatures of stone, wood, metals, &c. What I am now treating upon, is that which represents not only all manner of figures, in their proper colours, attitudes and shapes, as large as those that are lasting ornaments in churches, and other publick edifices, but also in small, and fit to grace the cabinets of the great and curious, and imitate a picture painted in miniature.

The antients, who practised this art with much skill and exactness, have left a variety of their performances, which are found not only in *Italy*, *Spain*, &c. but also here in *England*. Those remaining at *Rome* are the finest, in the temple of *Bacchus*, now that of *St. Agnes*; and there are also curious pieces of that kind seen at *Venice*, *Pisa*, *Florence*, and other places.

The modern artists have improved very much in this performance, and whatever traveller has been at *St. Peter's* and the palace of *Borghese* at *Rome*, *St. Mark's* at *Venice*, and the church of *St. Felicia*, at *Florence*, will confess to have seen wonders.

Such figures are composed, joined and cemented together of various coloured stones; but since nature has scarcely, at least not sufficiently, supplied the proper shades requisite for a masterly performance, that defect has been made up by counterfeiting those colours by art in glass, and this is done in the following manner.

The

The glass materials in the crucibles or melting pots being in fusion, put in such a colour as you would make your shades with, in the manner you have been before directed, in the art of making artificial gems, beginning with the lightest; having mix'd it well and taken out the quantity you think proper with an iron ladle, put it on a smooth marble, flattening it with another to a proper thickness, then cut it quick into small pieces, laying them when cold up in a box for use; then add more colour, and proceed as before, repeating it till you come to the deepest shade. If you would gild them, then wet them on one side with gum water, lay leaf gold upon them, and in an iron shovel, covered with pieces of other glass, heat them red hot in the mouth of a furnace; then take them out, and when cold, the gold will be so fix'd and firm that nothing can hurt it.

When you begin to work, lay a thick ground against the ceiling or wall, with plaister, and having your design ready drawn and painted on blue or brown paper, clap part of it upon the wet plaister, and with a pair of small plyers, take up the small stones, and press them in their proper places; thus form the figures and shades in their respective colours, as you are directed by your painted model. In this manner is done the history of our Saviour's walking with *Peter* on the sea, in *St. Peter's church at Rome*.

PART

P A R T XI.

Of several Sorts of COSMETICKS, ODORIFEROUS
WATERS, OILS, &c.*How to beautify the skin.*

TAKE rye bran, sift it through a fine sieve, and repeat it till it is clear from all the flower; then soak it for three or four hours in white wine vinegar, and putting in some yolks of eggs, stir it together, and distil it in *Balneo Mariæ*: the water thus drawn off is an excellent cleanser and beautifier of the skin.

Another.

TAKE parsley, nettle seed, peach-kernels, of each an equal quantity, boil them in fair water, with which wash your hands or face: *Or*,

Take lemons and hard boiled eggs, cut them in slices, and lay them one over the other in a still, the bottom of which you first cover with well washed turpentine. The water that is distilled from it preserve for use: *Or*,

Boil the blossoms of rosemary, allum and tartar in wine, with which wash your hands and face: *Or*,

Take slices of lemons and dry'd beans; let them soak in wine; add to it some honey, eggs, and goat's milk, then distil it: *Or*,

Diffolve

Dissolve camphire in pump-water, and wash yourself therewith.

A water to take off the spots in the face, and to prevent the hands from chopping.

TAKE a white pigeon, pluck off the feathers, cut off the head and feet, gut it clean, and then, together with two pints of milk, three ounces of cream, and six ounces of oil of sweet almonds, distil it in a glass alembick: with this water wash your hands and face every day; it will keep them always white, soft, and without any spots or pimples.

To take away little red pimples from the face.

TAKE two ounces of lemon juice, two ounces of rose-water, two drams of silver sublimed, and as much cerus; put all this together, and mix it up to an ointment: with this anoint your face going to bed; the next morning, when you get up, anoint it with fresh butter, and then rub it clean off.

A fine water for beautifying the face.

TAKE a couple of calves feet, boil them in 18 quarts of river water, to half the quantity; then put in of rice and crumbs of fine bread steep'd in milk, two pound; fresh butter two pound; the white of 10 new laid eggs; mix all together and distil it; put into the distill'd water a little camphire and allum, and you will have a fine beautifying wash.

An odoriferous water.

TAKE of fresh rosemary flowers two pound, amber one scruple, orange, lemon, and citron-water three pints; put this by in a well closed glass vessel for ten days; then distil it in *Balneo Mariæ*, and keep the water for use. *Or,*

T A K E

TAKE orange and green lemon-peel, of each half an ounce, cloves one scruple, fresh spike blossoms six ounces; mix all these things together, with three quarts of damask rose-water, let it stand covered up for some days, then distil it in *balneo mariæ*, and the water will be excellent.

To prepare the cloth of the Levant for ladies to colour their faces.

TAKE shavings of scarlet cloth, boil it for some time in water wherein quicklime has been dissolved: then strain it, and to the quantity of a quart put an ounce of roach allum, and the same weight of verdegrease, together with one quarter of an ounce of gum arabick: having boiled it for the space of half an hour, take an old piece of linen cloth, of what bigness you please, and put it into the decoction or red colour, cover the pan, and let the said liquid cool for the space of a day, then take out the cloth or handkerchief you have dyed, dry it in the shade, and keep it in a box among odoriferous and sweet-scented things, and use it when there is occasion.

To prepare oil of benjamin.

TAKE an earthen pot that is high and narrow, with a little border round it; put into it three or four ounces of clean benjamin grossly powdered; cover the pot with a pyramidal paper cover, and tie it round about under the border; set the pot into hot ashes, and when the benjamin is heated the flowers will sublime; take off the cover every two hours, and fix another in its place; stop up quickly in a glass the flowers you find in the covers, and when those which afterwards sublime, do begin to appear yellow, take the pot off the fire and let it cool. You will find a black and shining matter cleaving to the bottom of the pot, which is taken off with a warm spatula; it is light, easy broken, and of a strong smell if it comes near the fire; pulverize the same grossly and put it into a retort of a sufficient bigness, and fill it only a third part, place it upon the sand; and having fitted a receiver, lute the joints, and make a small fire underneath, in order to heat the retort, and to distil an oil, part of which will become thick in the receiver; continue the small fire till nothing more distils; keep this oil in

in a glass bottle, its colour is red, the odour is agreeable, and its taste sharp and pungent.

Oil of roses.

TAKE the seed of melons, well cleansed and stamped in a stone mortar, lay them in rows or beds, together with rose-leaves, for the space of eight days, then take a little linen bag, wet it in rose water; and put into it the melon seeds and rose leaves; having tied it close, put it between a press, and press out the oil; this oil is very precious, and therefore preserve it carefully closed up in a little phial.

Oil of cloves.

TAKE sweet almonds, scrape and cleanse them with a knife, break them in pieces, and steep them in rose water, stamp also cloves, temper and steep them likewise in rose-water, so long till it has extracted the virtue of the cloves, then put both the almonds, cloves, and the waters of each together, leave them till you find them swelled, then take them out, dry them in the sun, and when dry, put them again into the water to swell; repeat this five or six times; then put them into a press, and press out the oil; which keep in a phial stopped close. In this manner you may make oil of musk, amber, cinnamon, mace, nutmegs.

Queen of Hungary's water.

FILL a glass or earthen cucurbit, half full of rosemary flowers, gathered when in their prime, infuse them in spirit of wine, set it in a *balneum*, join to it the head of the receiver, luting the junctures well; give a digesting fire for three days; after which unlute them, and pour what has been distilled into the cucurbit; refit your alembick, and increase the fire strong enough to make the liquid distil so as one drop may immediately follow another; when you have drawn two thirds of it, and put out the fire, let the vessels cool, and unlute them, and you will find in the receiver a very good *Hungary* water; keep it in a phial well stoppt; it is good in palpitations and swooning, in the palsy, lethargy and hysterical diseases; the dose is from one dram to two. Outwardly it is used

used for burnings, tumours, cold pains, palsy, and is very reviving to the spirits.

Ladies do use it to beautify their complexion, by mixing half an ounce thereof with six ounces of lilly-water or bean-flower-water ; washing their faces therewith.

To make balls for taking out spots of oil or greafe.

TAKE soft soap, incorporate it with ashes of vines, finely sifted, of both an equal quantity : then add to it roach allum burnt, and tartar, well beat into powder, incorporate all together and form thereof little round balls, and lay them by for use when occasion requires to make use of them.

To prepare a leather strap.

PROCURE a piece of leather, very smooth on the flesh side, and about two inches broad, glew it to a thin board of the same breadth ; and when dry, smear it all over with tallow candle, and then hold it a little over the fire, 'till the greafe is penetrated thro' the pores of the leather : and this repeat three times ; afterwards, pour over it a little tripoly, washed clean, which with the greafe work into the leather, so long till the greafe becomes warm ; then pour on fresh tripoly ; repeating this operation four or five times, till the leather is fit for use. *Or,*

TAKE fine powdered emery, steep it in fair water, and then pour a good deal more upon it ; stirring it well together. Let it stand a while to settle, pour off the water, and put one end of a linen or woollen rag to the bottom of the settled emery, and let the other hang out, in order to draw off all the water from it, which being become dry, rub it into the greased leather, in the same manner as you did the tripoly ; only work in the emery with a piece of smooth ivory, or else with a burnisher ; after this stroak your razor softly over it, and the effect will be, that razors thrown aside as useles are now recovered to such a degree, as to be fit for shaving. Now as one razor is softer than another, you must pass a soft one on a strap, prepared with tripoly ; and a hard one upon a strap prepared with emery.

T

How

How to make Prussian blue.

TAKE a salt, which by chemists is call'd fix'd alkali; and is of the same nature with that of pot-ash, mix it up with some oily inflammatory matter: the blood of cattle, deficated, will answer the purpose as well as any thing: then calcine this matter in a crucible, till you see only a blue flame on its surface. All the saline part of this calcined matter you dissolve in hot water, then strain it. This lye you mix with allum and green copperas, both which ingredients you first dissolve separately in water. The mixture of these saline liquids causes a fermentation, they grow muddy and of an unpleasant green: afterwards you filtrate the whole through a brown paper, in glass funnels: the liquor passes clear and leaves a green settlement on the brown paper: then you pour an acid liquor, such as aqua-fortis weakened with water on those settlings, and they turn to a fine blue: which when dry you put up for use.

P A R T

P A R T XIII.

Of Artificial FIRE-WORKS.

HAVING, in the preceding seventh part of the *Laboratory*, already given a sufficient account not only concerning the nature and property, but also the management of saltpetre, in promoting of its growth, in cleansing and refining the same, &c. it would be needless here to enlarge upon that subject, except it were of such things that have there been omitted, and are of use in the management of artificial fire-works.

How to boil saltpetre to a powder.

TAKE a clean kettle or pan, put in as much saltpetre as to lie at least two fingers thick; pour on it so much water as will just cover it; put it on a slow fire, and when the saltpetre is dissolved, take off the impurities with a skimmer, and let it boil gently till it begins to thicken, keep it stirring continually, till it is turned to a white sand or flower; then take off the kettle, and pour out the saltpetre on a table or board, spreading it thin, to cool.

How to melt saltpetre.

PUT a crucible with saltpetre on charcoal; when melted, take off the scum carefully; then fling a little piece of brimstone upon it, and when that is burnt, pour the melted saltpetre on a clean metal plate or stone, and it will be of a fine white colour, transparent and like alabaster.

T 2

N. B.

N. B. To one pound of saltpetre take half an ounce of brimstone.

Of sulphur, or brimstone.

SULPHUR is by nature the food of fire; it is the principal ingredient in gun-powder, and all sorts of fire-works. Among brimstone, that which is of a high yellow, and which when held in one's hand, crackles and bounces, is the best.

How to strengthen brimstone.

MELT as much of the clearest brimstone as you will, in a kettle or other utensil, and when the greatest heat is over, then put into it, for each pound of brimstone, half an ounce of quick-silver, stir them well together, till the quick-silver and brimstone are united, then pour it out into brandy; instead of quick-silver you may use the same quantity of cinabar, and it will do as well.

How to break or granulate the brimstone.

TAKE some spirits, put a handful of brimstone therein, and let it dissolve; then take a broad stick, and stir it about till it grows mealy, and runs like sand. If you would have it strong and hard, fling a handful of saltpetre into it.

How to prepare the oil of saltpetre.

PUT some good refined saltpetre upon a dry and well plained deal-board, underneath which place a copper bason, round about make a coal fire, and the heat thereof will draw the saltpetre, changed into an oil, through the board, and it will drop into the bason: this you may continue as long as you will, by recruiting the board with fresh saltpetre.

To

To prepare oil of sulphur.

FILL a matrafs with fine pulverifed brimstone about one third full; on this pour as much nut or elder oil as will fill the matrafs half full, fet it in warm ashes, and let it stand for 8 or 9 hours; and the oil will change the brimstone to a fiery red oil.

To make fal-armoniac water.

TAKE three ounces of fal-armoniac, one dram of salt-petre, pulverise it fine, and mix it together; then put it into a matrafs, pour on it strong vinegar, and distil it over a slow fire; then dry and refine it.

To make camphire, and the oil thereof.

TAKE of pulverifed juniper-gum two pound, and of distil'd vinegar enough to cover it, put them together into a glafs phial; fet it for 20 days in warm horse dung, then take it out again, and pour it out into another glafs, with a wide mouth to it, expose it to the sun for a month, and you will have a concreted camphire, like a crust of bread, which is in some measure like the natural camphire: this, for use in fire-works, is wrought to a powder by grinding it with sulphur in a mortar.

The oil of camphire which answers the same end is produced by adding a little oil of sweet almonds, and working it together in a brass mortar and a pestle of the same metal; thus it will turn into a green oil.

How to prepare oil of brimstone and saltpetre at once together.

TAKE brimstone and saltpetre an equal quantity of each, mix them together, grind them to a fine powder, sift them through a fine sieve; then put it into a new earthen pot, pouring as much sharp vinegar or brandy to it as is sufficient to cover it; then lute up your pot close, so as to prevent any air entering into it, fet it in a warm place, till the
T 3 vinegar

vinegar or brandy is quite digested, then take the remains, and extract it in a chymical manner.

To prepare charcoal for fire-works,

COALS are a preservative, whereby the fire, which by the brimstone is brought into gun-powder, may not suffocate the strong and windy exhalation of the saltpetre.

The charcoals are of several sorts; some prefer those burnt of halle and willow wood; when you go to burn them, split the wood about one foot long, in four equal parts, scale off the bark, separate the pitch and hard knots; dry them in the sun or in a baker's oven; then make in the earth a square hole, line it with bricks and lay the split wood therein, crossing one another, and set it on fire; when thoroughly lighted and in a flame, cover the hole with boards, and fling earth over it close, to prevent the air from coming thereto, yet so as not to fall among the coals; having lain thus for 24 hours, take them out and lay them carefully up for use.

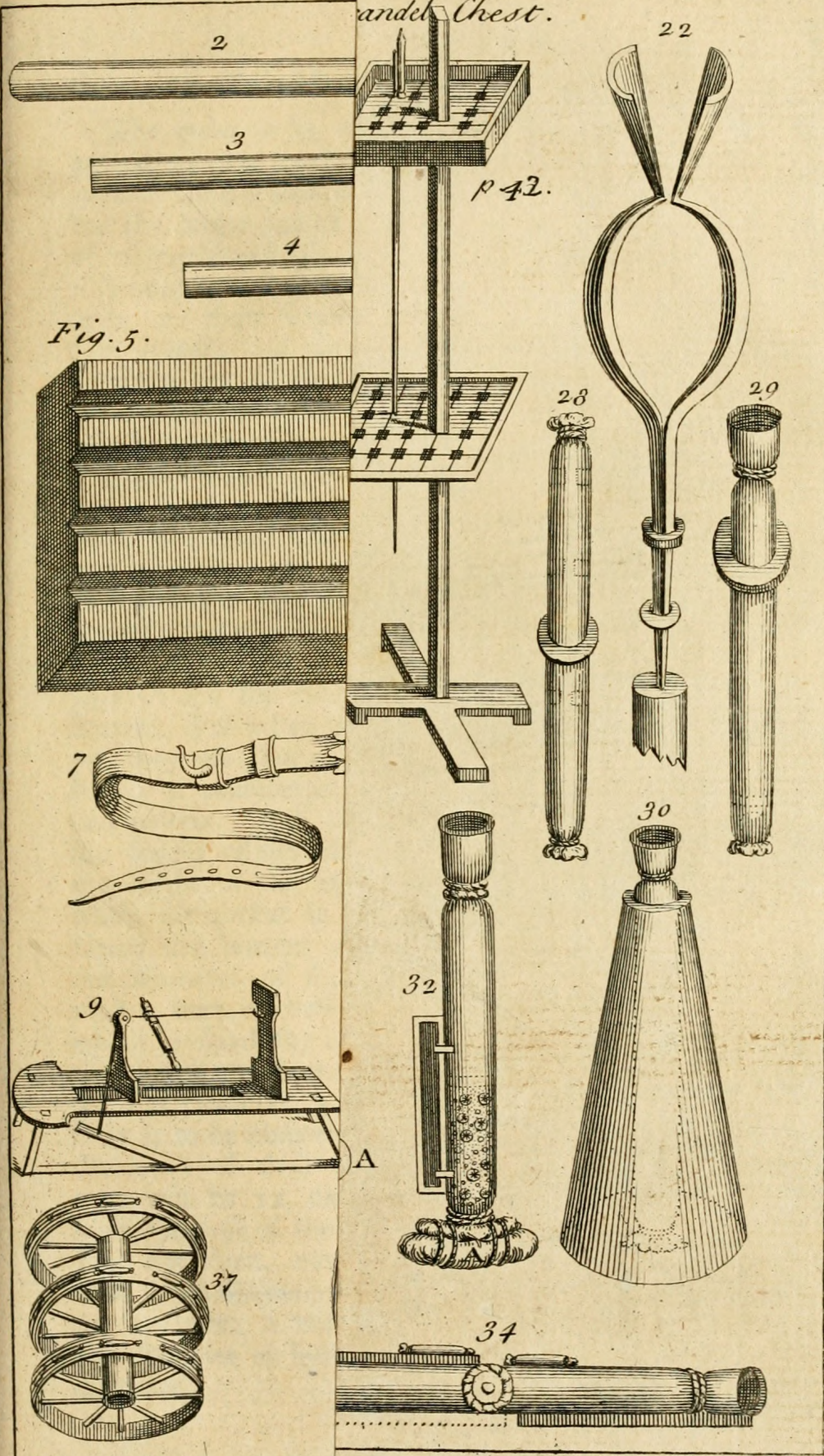
To make the moulds for rockets.

THE rockets bearing the pre-eminence, and being the principal things belonging to a fire-work, it is requisite to give some definition of every part of them, how they are made, finish'd and fired: in order to do this, I shall first endeavour to give the curious some idea concerning the moulds they are formed in; these are turn'd commonly of close and hard wood, as of white plumb-tree, box, chesnut, cypress, juniper, *Indian* wood, &c.

Some also are made of ivory, and for rockets of extraordinary large sizes, they are cast in brass or copper, and turn'd the inside in a nice manner, the foot or basis with its cylinder, wart or half bullet may in these, as in others, remain of solid wood. The whole is commonly turn'd in the size and form of a column in architecture, and embellish'd with ornaments according as you fancy.

The

Handel Chest.

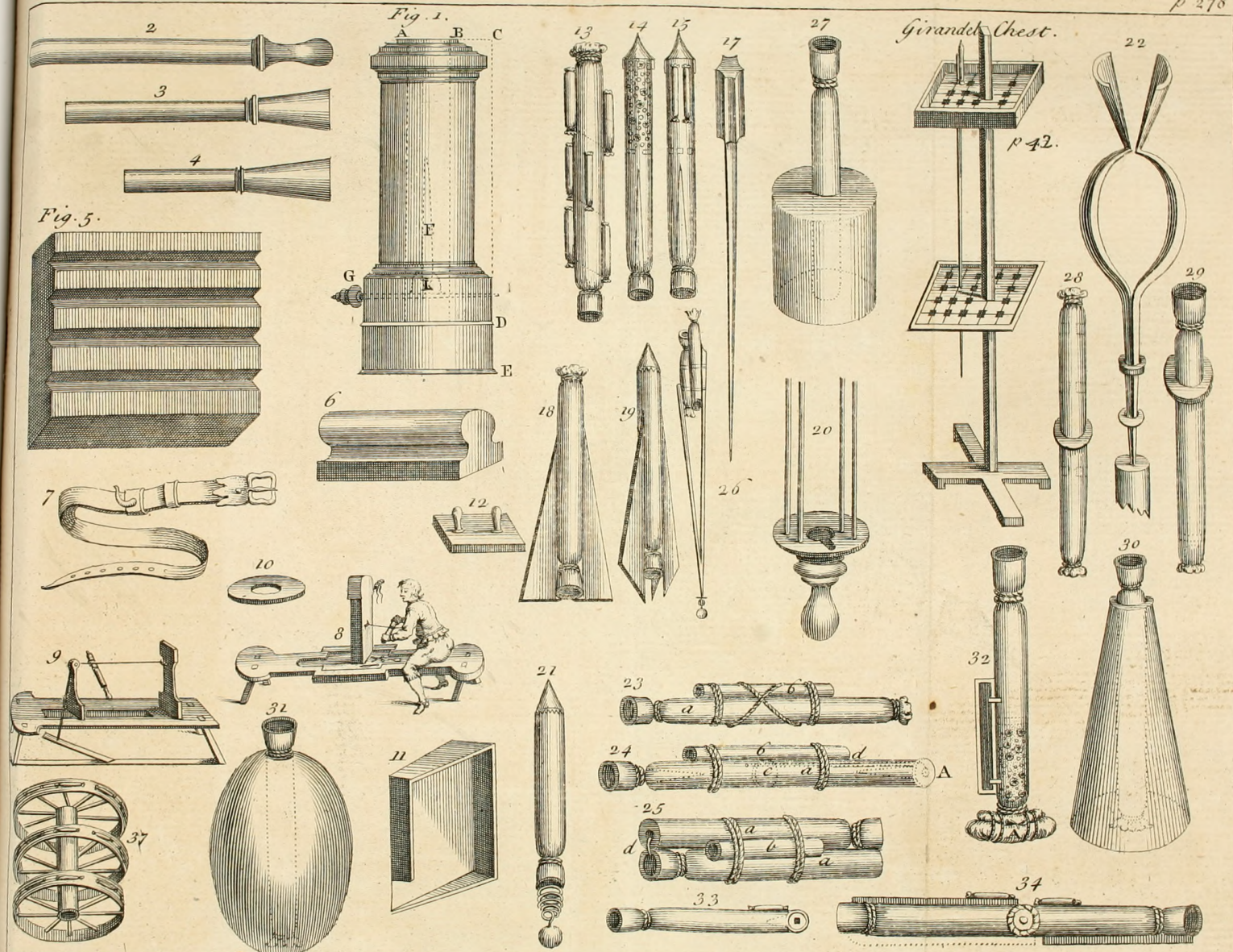


G. Smith del.
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Hulett Sculp
Original from
THE GETTY RESEARCH INSTITUTE

PLATE I.

p 278



G. Smith del.

Hulst Sculp

The order to be observed in the size of the cylinder: it is agreed by the most famous artificers, that the moulds of all rockets from a half to six pounds, ought to be six diameters; but the larger size of four, four and a half, or five diameters of their orifices high.

Those rockets which go under the denomination of small ones, are those whose inward diameter cannot receive a ball that exceeds one pound. The middling sort are those whose diameter can admit balls of one, two or three pounds; and great ones are such, whose bore will receive balls from three to a hundred pounds.

Rocket moulds, from some ounces to three pounds, are ordinarily seven diameters of their bore long, the foot two or three diameters thick, the wart two thirds of the diameter, and the piercer one third of the bore, the roller two thirds, and always one or two diameters from the handle longer than the mould; the rammer one diameter shorter than the mould, and somewhat thinner than the roller, to prevent the facking of the paper when the charge is ramm'd in, having always one still shorter, that when the shell of the rocket is ramm'd half full, you may use that with more ease. For the better illustration, see fig. 1. representing the mould with its basis, cylinder, bore and piercer. A B the interior diameter of the mould. C D the height of the mould, seven diameters; from D to E, is the height of the breech at bottom, which stops the mould when the rocket is driving, and this is one and $\frac{1}{3}$ diameter. Upon this bottom you have a solid cylinder, whose height is one diameter of the orifice A B; this cylinder is crowned with a wart or half bullet I, having a hole in the center, in which is fixed the iron or copper piercer F. G. an iron pin that keeps the bottom and cylinder together. 2. The roller. 3. The rammer. 4. The shorter rammer.

It is to be observed, that some of these moulds are made 9 diameters of their orifice long, the shell therefore with the wart will be 12 diameters. These sorts of rockets fly very high, because of their length, they containing a greater charge than the short, nevertheless the piercer needs to be no longer than seven diameters, but substantial, so as to keep in its proper attitude; it will require the dimension of two thirds of the diameter at bottom, and from thence tapering to half the diameter.

T 4

How

How to prepare cases for swarms or rockets.

THE cases or trunks of rockets are made of different sorts of things, namely of paper, wood, tin, pasteboard, linen, leather, &c.

In paper cases, which are for the generality most made use of, it must be observed, 1. That great care ought to be taken in winding or rolling them upon the roller, tight and close. 2. That the concave stroke be struck clean, smooth, and without large wrinkles: and 3. That each sort of cases be of an equal length and size.

The rocket shells being very tiresome for two persons to make by hand, a machine has been invented for the easement thereof. It is made of an oaken board, about two foot wide, and three or four inches thick, plain'd, smooth and cut out into channels or groves of different sizes, to serve for greater or lesser rockets, and is commonly called the fiddle; to these sort of fiddles are also made pressers, whereby the cases on the roller are pressed down with a heavy hand; the handle of the roller having a hole in the middle, a small iron bar is put in and as the man presses with one hand, he turns the roller with the other; and by this means the paper is brought as tight as it ought to be. See *fig. 5* and *6*.

For four and six pound shells it is to be observed, that each sheet of paper (except the first and last, in the part where the neck is formed) be a little moistened.

The necks of rockets may be formed several ways; for those of three quarters of a pound, a well twisted pack-thread will do, which having one end tied to a stick and put between one's legs, and the other to a post, will draw it close with ease. The large shells require more strength, one end of a strong cord being fastened to a post, and the other to the belt with a hook, as *fig. 7*. and this by main force draws the cord twisted about the neck of the case, as you see in *fig. 8*.

Some make use of a bench, on one end whereof is fix'd a post, to which a cord is fixed and conveyed over a pully and thro' a hole in the bench, to a treddle, to which it is fastened, whereby the necks are forced very tight. See *fig. 9*.

The

The necks of extraordinary large fized rockets are forc'd with strong cords over screws and round neck'd irons, proportioned to the size of the shell. See fig. 10.

The wooden, tin and paste-board rockets, are supplied with necks, turn'd of wood, joined, and fastened through the sides of the shell with wooden pegs.

How to prepare the charges for rockets, and order the fires thereof to be of various colours.

BEFORE you begin to charge the shell of the rocket, be very careful that the powder is well work'd and clean'd; that the saltpetre is thoroughly refined, and made into an impalpable powder; that the brimstone be well cleansed and brought to the highest perfection; that the coals be of lime-tree or other soft wood, well burnt, powder'd, dry'd and sifted, and all these ingredients be well mix'd together and searfed through a fine sieve.

When you are satisfied in those things, and have weighed the proportionable quantities of each, put the mixture into the work board fig. 11. and grind it therein with the grinder, fig. 12. for an hour together: then try your charge by sifting a little on a table, and if when lighted, it burns away in an even fire, and does not fly up, it is a sign that it is work'd enough; but if at one place it burns quicker than another, or doth stop its course, then you must grind it more. The charge being thus prepared, you must put it up safe in a moderate place, that is neither too hot, cold, nor damp, in a box or other dry vessel; and when you charge your rocket, then sprinkle and mix the charge with a little brandy.

Having ramm'd a rocket for tryal, fire it in a secure open place; if it mounts even and high, and gives a report as soon as it turns, it is a sign of being made to perfection; but if the rocket burst as soon as it is lighted, then the charge is too fierce; or if it rises a little, and falls back, then the charge is foul and weak; the former is rectified by adding more charcoal, and the latter by some meal-powder; for the rest it must be observed, that the larger the rockets be, the weaker must be the charge; and on the contrary, the smaller they be, the stronger must be their charge.

If

If you would represent a fiery rain falling from the rocket, mix among your charge a composition of powder'd glass, filings of iron, and saw-dust; this shower is commonly called the peacock's tail, on account of the various colours that appear in it.

You may also exhibit a variety of colours issuing forth from a rocket, by mixing among the charge a certain quantity of camphire, which produces a white or pale fire; rosin a red and copper colour; blood-stone, which has been nealed and beaten to a palpable powder, will yield a blood red; sulphur a blue; sal-armoniac a green; raw antimony a reddish or honey colour; ivory shavings a shining silver; filed agate stone an orange, and pitch a dark and deep colour'd fire; this must be manag'd with discretion, and practice will be the best teacher in that particular, for long lessons are more fit to perplex a young beginner than put him forwards.

The charges are commonly divided into three sorts or degrees, *viz.* in white, grey, and black. I have, the better to guide beginners in this art, set down several sorts of charges, according to the proportion of rockets, but without distinguishing the three several colours; wherefore you have to observe, that to the grey charges are four ingredients, *viz.* meal-powder, saltpetre, brimstone and charcoal; to the white-charges three ingredients, *viz.* saltpetre, brimstone, and charcoal; and to the black charges two ingredients, *viz.* meal powder and charcoal.

Charges for land swarmers, or small rockets.

MEAL powder one pound, and charcoal one ounce.
Or,

Meal powder five ounces, and charcoal half an ounce.

Meal powder fifteen ounces, and charcoal two ounces.

Meal powder six ounces, saltpetre four ounces, brimstone one ounce, charcoal one ounce and three quarters. This last may be used for the fuzee of others.

Charges

Charges for water rockets.

Saltpetre two ounces, brimstone half an ounce, and charcoal one ounce and a half.

Meal powder one pound and a half, saltpetre four pounds, brimstone two pounds, and charcoal five ounces.

Meal powder four ounces, saltpetre one pound, brimstone eight ounces, and charcoal one ounce.

Saltpetre two ounces, brimstone half an ounce, and charcoal half an ounce.

A general charge for rockets of two or three ounces.

MEAL powder twelve ounces, saltpetre two ounces, brimstone half an ounce, charcoal one ounce and a half,

Charges for rockets of four, five, and six ounces.

POWDER fifteen ounces, saltpetre twelve ounces, brimstone one ounce and a half, and charcoal four ounces.

Powder one pound and a half, saltpetre one pound and a half, brimstone ten ounces and a half, and charcoal twelve ounces.

Powder two pounds, saltpetre one pound, brimstone three ounces, and charcoal fourteen ounces and a half.

Powder eight pounds, saltpetre twelve pounds, brimstone two pounds, and charcoal four pounds.

Powder twelve ounces, saltpetre two ounces, brimstone two ounces, and charcoal two ounces.

Saltpetre four pounds, brimstone fourteen ounces, and charcoal one pound.

Powder three ounces, saltpetre half an ounce, brimstone half an ounce, and charcoal half an ounce.

Powder one pound and a half, charcoal three ounces and three quarters.

For

For eight, nine, and twelve ounce rockets.

MEAL powder eighteen pounds, saltpetre eight pounds, brimstone one pound, and charcoal four pounds.

Powder four pounds, saltpetre three pounds and a half, brimstone fifteen ounces, charcoal one pound four ounces.

Powder three pounds, saltpetre two pounds, brimstone two pounds, and charcoal one pound.

Powder three pounds, saltpetre two pounds, brimstone one ounce, and charcoal one pound.

Powder nine pounds, charcoal one pound eight ounces.

Saltpetre two pounds four ounces, brimstone eight ounces, charcoal fourteen ounces, and antimony four ounces.

Saltpetre one pound two ounces, brimstone two ounces, and charcoal four ounces.

Saltpetre ten ounces and a half, brimstone one ounce, charcoal three ounces, and brass file-duft half an ounce.

Saltpetre two pounds four ounces, brimstone eight ounces, and charcoal fourteen ounces.

For one, and one and a half pound rockets.

MEAL powder three pounds, saltpetre four ounces, brimstone one ounce, and charcoal four ounces and a half.

Powder thirty-two pounds, brimstone two pounds, and charcoal six pounds.

Powder two pounds, saltpetre two pounds and a half, brimstone twelve ounces, and charcoal one pound three ounces.

Powder six pounds and an half, charcoal one pound.

Powder three pounds, saltpetre fifteen ounces, brimstone four ounces, and charcoal seven ounces and a half.

Powder four pounds, saltpetre one pound eight ounces, brimstone ten ounces, and charcoal one pound twelve ounces.

Powder two pounds, saltpetre one pound four ounces, brimstone one ounce, and charcoal eight ounces and a half.

For

For two and three pound rockets.

MEAL powder three pounds eight ounces, faltpetre three pounds ten ounces, brimstone one pound four ounces, and charcoal one pound three ounces.

Saltpetre four pounds eight ounces, brimstone one pound eight ounces, and charcoal one pound four ounces.

Saltpetre sixty pounds, brimstone two pounds, and charcoal fifteen pounds.

Powder two pounds thirteen ounces, faltpetre fifteen ounces, brimstone four ounces, and charcoal seven ounces and an half.

Powder twelve ounces, faltpetre one pound eight ounces, brimstone six ounces, and charcoal six ounces.

Powder four pounds, faltpetre nine ounces, brimstone three ounces and a half, and charcoal ten ounces and a half.

Powder one pound, faltpetre eight ounces, brimstone two ounces, and charcoal three ounces.

Powder eleven pounds, and charcoal two pounds ten ounces.

Saltpetre six pounds four ounces, brimstone one pound, and charcoal two pounds and a half.

For four and five pound rockets.

MEAL powder six pounds, faltpetre four pounds, brimstone one pound and a half, and charcoal two pounds six ounces. *Or,*

Saltpetre sixty four pounds, brimstone eight pounds, and charcoal eight pounds.

For six, eight, or nine pounders.

MEAL powder twelve pounds three quarters, faltpetre six pounds, brimstone two pounds and a half, and charcoal five pounds and a half. *Or,*

Saltpetre thirty-five pounds, brimstone five pounds, charcoal ten pounds.

Meal powder twenty two pounds and a half, and charcoal five pounds twelve ounces.

Meal

Meal-powder one pound, saltpetre half a pound, brimstone two ounces, and charcoal three ounces.

Saltpetre nine pound, brimstone one pound nine ounces, and charcoal three pound and a half.

For ten and twelve pounders.

Saltpetre sixty-two pounds, brimstone nine pounds, charcoal twenty pounds.

Powder eleven pounds, saltpetre seven pounds, brimstone three pounds, and charcoal six pounds.

For fourteen, fifteen and sixteen pounders.

POWDER ten pounds and a half, brimstone nine pounds three quarters, and charcoal seven pounds.

Saltpetre twenty-three pounds, brimstone eight pounds, and charcoal sixteen pounds.

For eighteen or twenty pounders.

POWDER twenty-two pounds, saltpetre sixteen pounds, brimstone seven pounds, charcoal thirteen pounds and a half.

Saltpetre twenty-four pounds, brimstone twelve pounds, charcoal twenty-six pounds.

For thirty, forty, and fifty pounders.

POWDER eight pounds, saltpetre sixteen pounds, brimstone two pounds, and charcoal four pounds.

Saltpetre thirty pounds, brimstone seven pounds and charcoal eighteen pounds.

For sixty, eighty, and a hundred pounders.

Saltpetre thirty-six pounds, brimstone ten pounds, and charcoal eighteen pounds.

Saltpetre fifty pounds, brimstone twenty pounds, and charcoal thirty pounds.

T.

To bore the rockets, or ram them over the piercer.

SINCE the boring of rockets is one of the principal things belonging to them, for their operating well, the bores are to be made in proportion to the size of the rockets, for some of them are bored tapering to a point; others are hollowed square, running also to a point; and others are rammed over a round piercer, which is fixed in the wart of the rocket mould. See fig. 1. I, and stands perpendicular, running tapering to a point. The stronger the charge of the rockets, the narrower should be the bore, and the weaker the charge, the deeper and wider; for if a strong charge is bored too deep, it will break in ascending, and if it is bored too little, and the charge too slow, it will fall to the ground without any effect: they are commonly in middling charges bored two thirds of the tube from the neck.

The boring must be performed strait and even, and although some will give themselves the trouble to bore them by hand, it is better, when a quantity is to be bored, to send them to a turner.

The rockets should be bored but a few days before they are to be used, and kept in dry places, which you must also observe in other materials for fire-works.

For garnishing of rockets.

THIS is done several ways, for they may be both within and without furnished with crackers. On the outside it is done in the following manner, *viz.* That end of the rocket which is solid, is divided into three equal parts, and then bored in the middle of each, quite to the charge; at the bottom of these holes paste a ring of thin paper, upon which fling some meal powder; then fix in the crackers, stuffing the sides with some tow or flax, and over that paste a covering of paper, to close the opening between the rocket and crackers.

The inside is finished thus: put a small round board, (in which you have bored several holes) upon the charge; then strew meal powder in them, and fix your crackers, cover it with a cap, and paste it to the outside of the rocket.

You

You may also furnish rockets both within and without with sparks, stars, and fire-rain, when those materials are joined either within or without. You may also fix to the large rockets, swarmers, by boring a touch-hole in both, filling them with meal powder, and after the touch holes are fixed exactly on one another, glew them together with a bandage of paper; thus you may mark a winding figure with a thread on a rocket, and place your swarmers accordingly. See fig. 13. You may also, instead of swarmers, place a globe on the top of the rocket, charged with the composition of rockets, and fill'd with crackers; this globe must have a touch-hole, and be lighted before the rocket is let off, and it will have a good effect. Several other things may be done that way, as the genius of every virtuoso in the practice thereof will direct him. See fig. 14, 15.

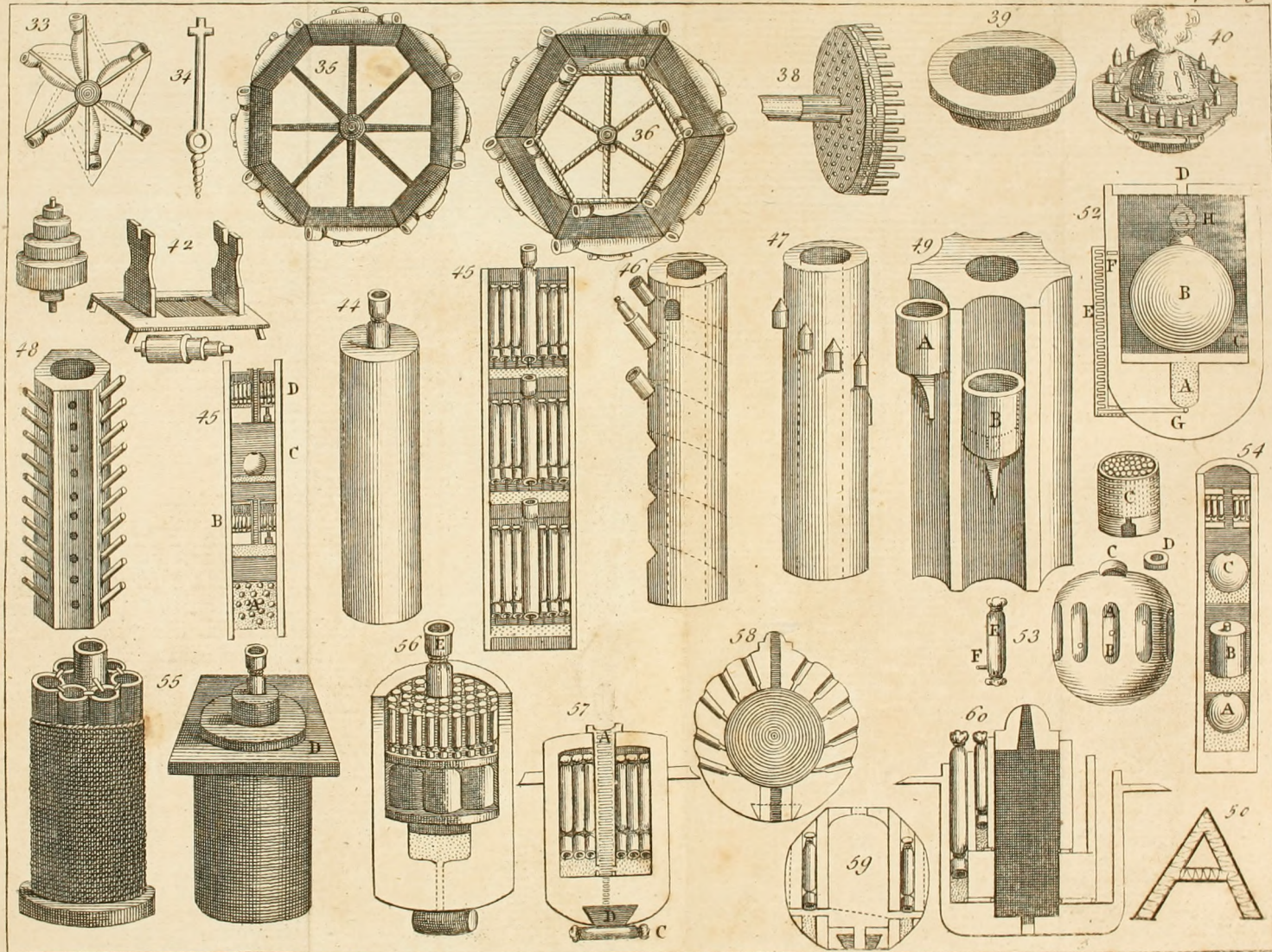
How to proportion the rocket-poles and sticks.

IT is common to tie but one rocket to a stick; but six or seven may be placed round the thick end thereof, which must be worked with groves, as you see fig. 17. But as no rocket would ascend high, if it were not for the true balance observed in the pole or stick, you must further observe, that these sticks are made of light, dry, and strait wood, and must (to one and two pound rockets) be seven times as long as the rocket; which proportion of the small ones of seven diameters, must also be observed in the larger sort: that end where the rocket is tied to, must be two fifths, and below, one sixth of the diameter thereof; it is best to give the turner an unbored rocket and one that is bored, thereby not only to measure the length, but also balance the weight. After the rocket is tied to the stick, take it four inches from the neck of that rocket not yet bored; and from the neck of the bored one about two or three fingers, so as to stand on the back of a knife or one's finger, in an equilibrium. In large rockets the poles must be eight or nine rockets long, and to find their balance, you take their libration twelve inches from the neck.

Rockets

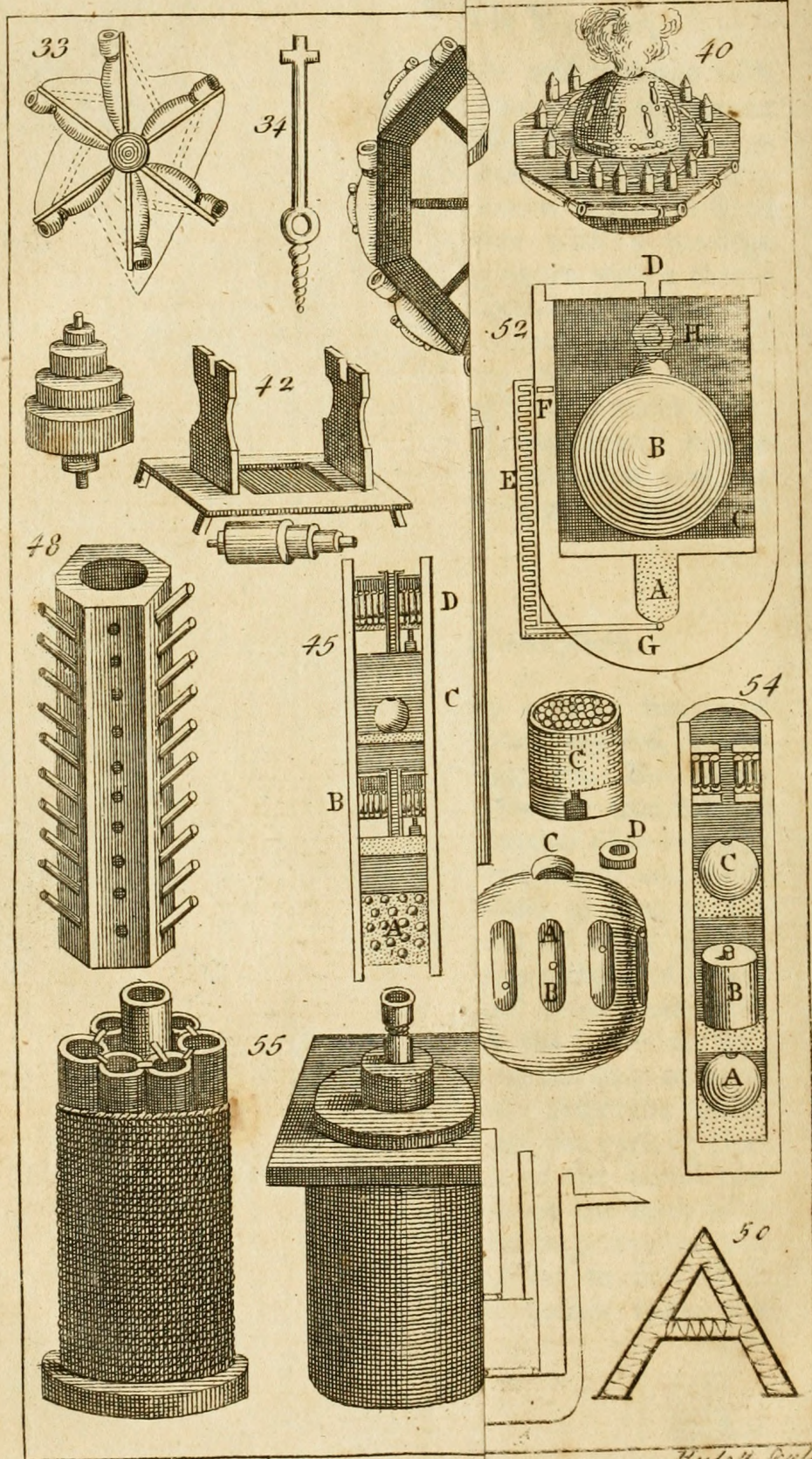
PLATE II.

p. 289.



J. Smith del.

M. A. S. sculp.



J. Smith del.

Hutchinson sculp.

Rockets without sticks.

THERE are also rockets made without sticks. Fix to the small ones, from four to eight, nine, or ten ounces (after they are bored and rammed) four wings, in the nature of arrow feathers, made either of light wood or paste-board, which are glued crossways to the rocket: their length must be two thirds, and the breadth below, one sixth of the length of the rocket; the thickness may be one eighth of the diameter of the mouth thereof. See Fig. 18, and 19. These sort of rockets are fired on a board or stand, placed between four small sticks; as you see in Fig. 20.

Others fasten one end of a wire, which is about a foot long, twisted like a screw, to the mouth of the rocket, and hang an iron ball to the other end, of an equal weight with the rocket. See Fig. 21.

Of girandel chests, how and with what the rockets are fired therein.

THE girandel chest is made of wood, of what size you think proper, according to the number of rockets you design to fire at once.

The method of firing those rockets is performed several ways; some fill the necks of them with meal-powder, others with quick match, wherewith, or with gun match, they fire them: the best way to light the girandel or other fire-works, is a match prepared on purpose in the following manner:

Cut some slips of paper of the length of half a sheet, and about one or two inches wide, roll and glew each of them together over a little round and smooth stick of a quarter of an inch thick; this done take it off, when dry, and fill it with the composition hereafter mentioned, ramming it in by little and little with a less stick than that upon which you rolled the shell. These sort of matches are put upon pointed pinchers, as you see in Fig. 22. and when they are lighted, cannot be extinguished either by rain or wind.

U

The

The composition.

MEAL powder three ounces and a half, saltpetre seven ounces, and brimstone three ounces three quarters, moistened with linseed oil.

Meal powder one pound, saltpetre one pound, and brimstone thirteen ounces, moistened with linseed oil.

Meal powder one pound, saltpetre one pound four ounces, brimstone four ounces, charcoal two ounces, rosin two ounces and a half, moistened with turpentine and linseed oil, and worked well together.

Meal powder twelve ounces, saltpetre two ounces, brimstone three ounces and a half, charcoal an ounce and a quarter, turpentine one ounce, and tallow three ounces and a quarter; first melt the turpentine and tallow together, then stir the other ingredients among it, and pour it in the paper shells; when dry, they are fit for use.

Of rockets that run upon lines, or ropes, from one place to another.

TH E S E are made several and different ways, and to give them the more shew, some garnish them with figures of various devices.

The first sort is contrived by fixing two iron rings, or a wooden tube, to a rocket, fill'd with a certain quantity of a suitable composition, and bor'd as usual; through these rings, or tubes, is put a line, on which the rocket is to run; this is of the most simple kind, for being arrived at the place where the duration of its combustible matter will allow it to reach, it there stops. This sort is represented in Fig. 23.

For the second sort, fill any rocket, whose orifice is equal to that of the former, but much longer, to the height of four diameters, bore it to the depth of three and a half. Upon this composition put a cap or little wooden partition, without any hole through it; glew this to the inside of the rocket, or secure it any other way to prevent the fire, when arrived to that place, from catching hold of the composition contain'd in the other part of the case. This done, charge the remainder of the rocket to the same height as before, namely to four
dia-

diameters, three and a half must be bored; after this choak the rocket at top, and make a little receptacle for the priming, as at the other end; or else fit a round piece of wood to it, with a hole through the middle, as you see in A, Fig. 24. which you cover with a little cap; to this add on one side a tube made of a very thin iron plate, which fill with meal-powder; then bore a hole through the side of the rocket, near the other side of the partition that is in the middle, fill it with meal-powder; this is done to convey the fire thro' the tube to the receptacle A, where it lights the other rocket, and consequently obliges it to return back to the place whence it came; the upper part which holds the priming must be covered with paper, as well as the small tube, that conveys the fire from that to the other end. This rocket must also have two iron rings or a wooden tube to run along the line. You may make the diversion the greater, by tying small paper crackers all round. The contrivance of this rocket is very pretty. You have the representation plain in Fig. 24, 25.

The decorations and devices that are usually fixed to these running rockets, may be either flying dragons, pigeons, mercuries, cupids, or any other fancy, as the occasion of a feast or rejoicing requires.

Charges for the line rockets.

MEAL powder three ounces, saltpetre one ounce and a half, and charcoal three ounces, will be a right proportion for three, four, or six ounce rockets.

Meal powder eight ounces, saltpetre two ounces, brimstone half an ounce, and charcoal one ounce.

Meal powder nine ounces, saltpetre one ounce, brimstone three quarters of an ounce, and charcoal four ounces.

Meal powder fourteen ounces, saltpetre seven ounces, brimstone two ounces, and charcoal four ounces.

These charges may be used for sixteen and twenty-four pounders.

Meal powder one pound, saltpetre half a pound, brimstone three ounces, and charcoal five ounces. This charge is proper for three quarters and one pound line-rockets.

It will be adviseable to make some trials of the charges, that you may be sure of not failing in the performance: See Fig. 23, 24, 25, where *a* is the rocket, *b* the tube, or instead thereof some rings that slide upon the cord, *c* the partition, *d* the pipe for the communication of the fire from one rocket to another.

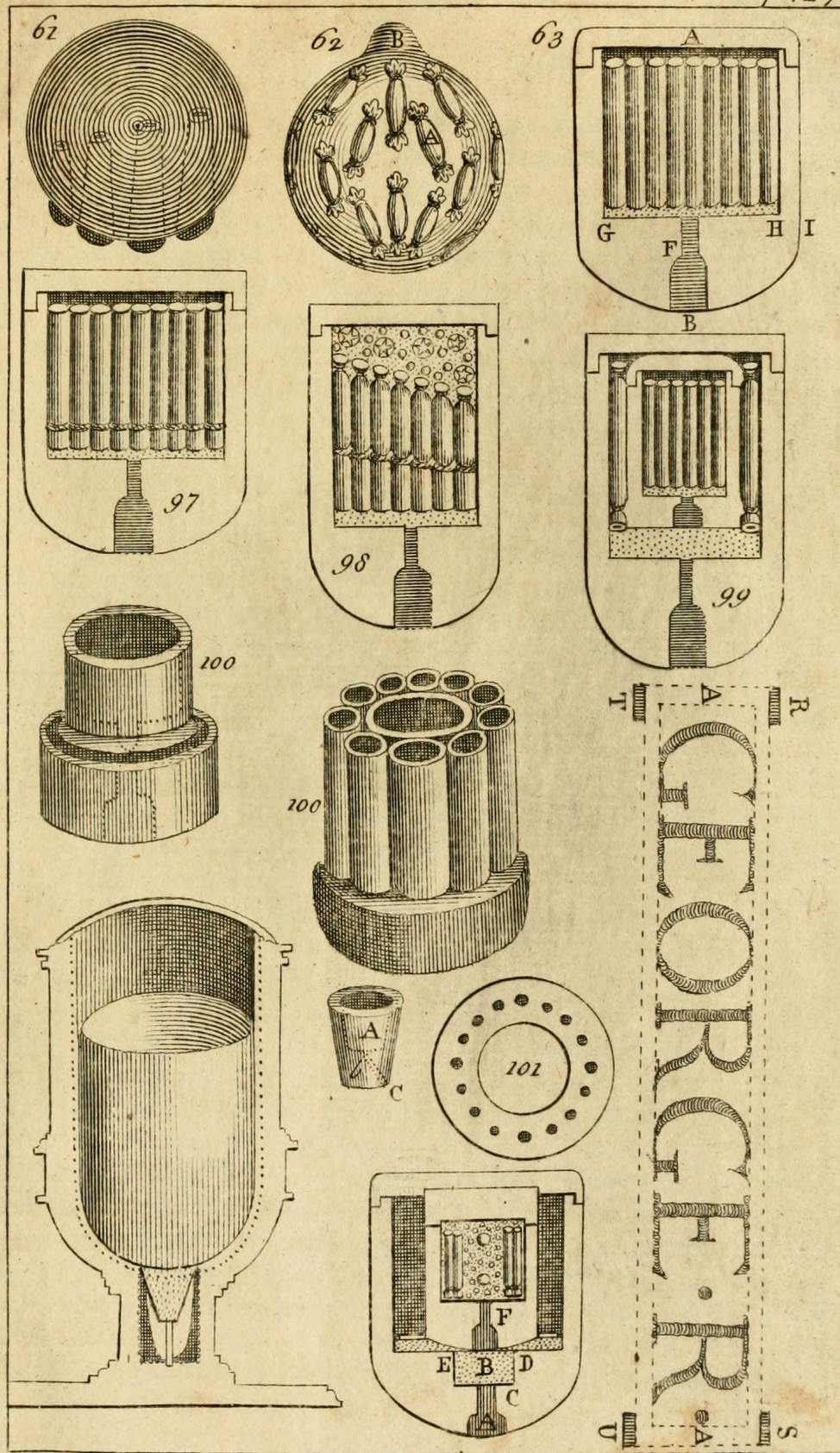
How to join two rockets to one another, the one to burn in the water; and the other suddenly to fly up into the air.

TAKE two rocket-shells of equal dimensions, fill one with a good charge quite full; the other charge bore and tie to a stick as usual; the former you glue upside down with a little glue to the middle of the latter, and towards the end tie it round with a cord, which is somewhat longer than the rocket stick; to the end thereof fasten a ring, and in that a leaden ball, which is to keep both rockets in a due position on the surface of the water; through this ring put the end of the stick, which is provided with a cross that is somewhat wider than the diameter of the ring, and keeps the cord, ring and ball under water: the communication of the fire must be made below the rockets, by a small pipe, fill'd with meal powder very secure, so as to keep it from the water; for as soon as the water-rocket is burnt to the end, the fire will make its way through the pipe, and the land rocket will disengage itself by its force from the case of the other, and leave the cord, ring and ball, behind in the water: See Fig. 26.

a the land rocket, *b* the water rocket, *c* one end of the cord tied to the water rocket, *d* the other end of the cord fastened to a ring and leaden ball, *e* the wire that keeps back the ring, *f* the little pipe for communication of the fire.

How to make water-rockets, water-brands, water-cats, water-ducks, &c. that turn themselves in the water.

THE cases for the water-brands, and also their sticks, must be made something longer than ordinary, and be fill'd with a composition of coarse coal-dust, small rubb'd tanners



G. Smith del.

Hallett sculp.

ners bark or saw-duft, but in the same method as sky-rockets. The whole case is to be nine or ten diameters long, and must be divided into five equal parts, and to be charg'd two fifths full of composition: upon this charge a report of a quarter high, and upon that fine iron flakes, in order to sink it, then cover it with paper, and draw it together with a cord; the charge is lifted up a little in the neck, and supplied with brandy-dough, or meal-powder moistened with brandy, then glewed over with paper; and having fixed a wooden swimmer below the neck, it is dipped in wax and pitch, and then it is ready.

Water-crackers which turn in the water are thus prepared.

This case is made nine or ten diameters long, the neck is drawn quite close, and charged with meal-powder almost half full: upon this a partition is made with a hole in it, then put corn'd powder for a report; upon that is placed another partition; the rest is filled with meal-powder, and the end tied close, and the paper cut short at both ends; when these crackers are to be fired, make a touch-hole at the end of both, reversed, and having filled them up with meal-powder, and covered them well with brandy dough, you may fire and fling them into the water, having before dipt them in melted wax, or pitch.

It is to be observed, that to the water cat-cases, one may proceed thus from one ounce to half pound crackers; but if larger, they are too heavy, and will not so soon turn up again in the water, till some parts of them are consumed; wherefore to remedy this, put in the case first three measures of charge, upon this put a little corn-powder, then again two measures of charge and a little corn-powder, and proceed thus as far as the report; upon the charge is placed a partition of wood with a hole in it, on that a report of good corn-powder, then tie it close: further, open it a little, putting some meal-powder to it mixed with brandy; and when you would use it, anoint it all over with either grease or linseed oil. The water-crackers or divers are commonly rammed in one, one and a half, and two ounce cases, stratified in the manner just mentioned, taking two measures for each lay of water cat-charge, and a little corn-powder between each.

There are other sorts of rockets, that may be represented swimming on the water: these are made in the same manner as the one, or one ounce and a half rockets, bor'd one third in the charge, then put into a paper cylinder with two small wooden heads, or basis, having a hole bored to the centre of each: the height of this cylinder must be equal to half of the rocket, and the whole through the centre of each head fitted exactly to the rocket; when you have fixed every thing to a nicety put it into melted wax or pitch; and when cold, you may fire and fling it into the water. See Fig. 27, 28, 29.

You may also put these sorts of rockets into a paper cone, and fasten it to the neck of the rocket; or else in a bladder full of wind, which, instead of dipping in melted wax, do over with a mixture of four parts of linseed oil, two parts of bole armoniac, one part of white lead, and half a part of ashes. Vid. Fig. 30, 31.

One may mix along with the reports of the rockets certain sparks and stars intermix'd with meal, and corn-powder; to this is fix'd an iron or wooden tube B, from each end of this goes another smaller tube C D, all having communication with one another, also with the composition, add the stars, &c. These are fill'd with meal-powder, cover'd over with paper, dipp'd in wax or pitch, and the counterpoise A being fix'd below, it is fired. As soon as the composition is burnt down to the cap, it is conveyed through the small tubes *a a* to the lower part, where beating out the partition, it disperses the powder, stars, &c. to the air. See the figure.

Charges for water-rockets.

MEAL-powder six ounces, rosin one ounce, charcoal three quarters of an ounce, saltpetre one ounce, corn-powder one ounce.

Saltpetre one pound, brimstone eight ounces, meal-powder eight ounces, and charcoal four ounces and a half.

Saltpetre four ounces, brimstone three ounces, and charcoal three quarters of an ounce.

Meal-powder one pound and a half, saltpetre half a pound, brimstone four ounces and a half, charcoal six ounces, coarse coal

coal two ounces and a half, and lead, for sinking, one ounce.

Meal powder two pound, saltpetre one pound, brimstone ten ounces, charcoal eight ounces, coarse coal three ounces, sinking lead one ounce and three quarters, for three quarter ounce rockets.

Meal powder two pounds, saltpetre two pounds, brimstone one pound, charcoal four ounces, coarse coal three ounces, tanners dust two ounces and a half, saw-dust two ounces, glass-powder one ounce, sinking lead one ounce and three quarters, for one pound rockets.

Meal-powder half a pound, saltpetre three quarters of a pound, charcoal five ounces, saw-dust half an ounce, and a quarter of an ounce of fine chopped cotton, boiled in saltpetre lee.

Charges for water-crackers.

MEAL powder two pound and a half, saltpetre one pound and a half, brimstone ten ounces, charcoal eleven ounces, coarse coals nine ounces, the sinking is, to two ounce crackers, a quarter of an ounce of lead.

Meal powder two pounds and a half, saltpetre two pound and a half, brimstone one pound five ounces, saw-dust twelve ounces, charcoal three quarters of a pound, coarse coals half a pound, the sinking a quarter of an ounce.

Meal-powder four ounces, saltpetre five pounds, brimstone two pounds and three quarters, tanners dust one pound and a half, charcoal one pound, coarse coals two pounds and three quarters, glass-dust four ounces, lead three quarters of an ounce.

Charges for tumbling water-crackers.

MEAL powder one pound, salt-petre one ounce, and charcoal one ounce and an half.

Meal powder one pound, salt-petre eight ounces, brimstone three quarters of an ounce, and charcoal one ounce and three quarters.

Meal powder three quarters of a pound, charcoal four ounces ; for one and a half or two pound rockets.

Charges for water-cats.

MEAL powder two parts, saltpetre four parts, brimstone one part, coarse coals two parts, saw-dust two parts, and antimony three parts, moistened with linseed oil.

Meal powder two ounces and an half, saltpetre three ounces and a half, brimstone two ounces and a half, and antimony half an ounce.

Meal flour one pound; saltpetre two pounds, brimstone one pound, and charcoal one pound.

Saltpetre fifteen ounces, brimstone five ounces, saw-dust eight ounces, and antimony two ounces.

Some general remarks upon rockets.

1. **Y**OUR rockets must have their proportionable height, according to the diameters of their orifices.
2. Their necks must be drawn or choak'd firm, and to prevent the cord giving way, they must be glued over.
3. Prepare your composition just before you want it.
4. Let it be neither too damp nor too dry, but sprinkle it over with a little oily substance, or a little brandy.
5. When you drive your rockets, put always equal quantities of composition in your cases at a time.
6. Carry with your mallet an even and perpendicular stroke, when you charge your rockets.
7. The cavity must be bored upright and perpendicular, exactly in the middle of the composition.
- 8 Bore your rockets just before you use them; then handle them carefully, lest their form should be spoiled.
9. Let

9. Let the sticks and rods be well proportioned, strait and smooth.

10. Put your rockets, when completed, in a place that is neither very damp nor dry.

11. Let most of your rockets have at top a conic figure, by that means they will the easier shoot through the air.

12. Avoid, if possible, a damp, foggy, rainy or windy night, to play your rockets.

Defective rockets are chiefly discovered by the following observations.

1. **W**HEN they are fired, and in mounting two or three perches they break and disperse, without performing their proper effects.

2. When they remain suspended on the nail, and waste away slowly, without rising at all.

3. When they form an arch in their ascent, or a semicircle, and return to the ground before their composition is burnt out.

4. When they mount in a winding posture, without an uniform motion.

5. When they move on slowly and heavy.

6. When the cases remain on the nails, and the composition rises and disperses in the air.

More of these vexatious accidents will sometimes frustrate the hopes of a young practitioner, but as the above are the principal ones, he must endeavour to avoid them in his first beginning.

Of

Of rocket-flyers, and the manner of charging them.

TH E S E are of two sorts, namely, the single and double, the latter are made after the following manner :

Have a nave or button turned, the dimension of three inches, together with two knots upon it, perpendicular one against the other, of an inch and an half long, and so thick that both rocket cases may fit over them; there must also be a hole of the third of an inch in the centre of the nave, for the iron pin to go through, on which it is to fly; after this take two rocket cases, of equal dimensions, which are choaked quite close at the neck, and glewed: ram in the charge so far as to leave only room to fix them on the two knobs upon the nave: this done, bore into both rockets, near the closed-up necks, small touch-holes, and one more near the pin, in that which is to burn first; from this hole, carry a little pipe to the hole near the neck of the other rocket, having first filled it with meal-powder, that when the rocket is almost burnt out, the second may be lighted by the first. The three touch-holes stand in one row, and you may on the other side fix a couple of reports, which will cause a swifter motion.

The single flyers are made with more ease, the neck in these must not be tied close as in the former, but they must be fired in that place; but these don't turn so well as those that are made double, the figures hereof will give you a fuller idea to manage them. See fig. 33, 34.

Of fire-wheels.

OF these there are three sorts, viz. single, double, and triple; some of their fells are of a circular form, others an hexagon, octagon, or decagon form, some like a star without fells; some, and the most of them, are made to run perpendicular to the earth; others horizontal; all may be ordered so as to serve either on land or water.

The

The fire-wheels that are to be used on land, turn upon an iron pin or bolt, drawn or screwed into a post. The nave is turned of close and firm wood, in which the joiners glew the spokes, according to the number of the fells, which must be carefully joined together; then have a groove hollowed round, so deep that the rocket or case may be about half lodged therein. See fig. 35.

The double wheels must have their fells turned stronger and wider, with a groove for the rockets, not only at top, but also on one side thereof; plying the necks of the rockets at top, to the right, and those of the sides to the left hand. Vid. fig. 36.

A triple wheel has a groove at top, and one at each side; the matches are laid from one groove and rocket to another, with small pipes filled with meal-powder: you may also make a triple wheel on a long nave, and observe the placing of the rockets on each, contrary one to the other; and the communication you are to make with small pipes, which, after they are fixed, you are to cover and glew over with paper. Vid. fig. 37.

Your rockets being ready and cut behind a little shelving, bore them; the first three diameters of its orifice, the second two and three quarters, the third two and a quarter, the fourth two diameters, the fifth one and three quarters, the sixth one and a half; the seventh one and a quarter; the eighth one diameter; always the latter something shorter than the preceding; after this they are primed with meal-powder worked up with brandy, and when dry, glewed in the above described grooves; you must bear the first fired rocket's neck up above the rest, underlaying it with a tin plate, or any thing else; the same you must observe in the head of the last fired one, wherein you put the charge of a report; you may also glew on every end of the rockets, a report of paper, with small pipes of copper, or goose-quills, which are fixed one end in the side of the rocket, and the other in the report. When all is dry, then you may cover your wheel on one or both sides, with linen or paper, in what form you would have it.

The horizontal wheels are made like the others with fells, or out of one entire piece; their grooves are furnished with rockets, and their plane garnished with crackers. Vid. plate I, fig. 38.

A

A fire wheel which is to whirl horizontally in the water must be thus ordered :

Take a pretty large wooden dish or bowl, that has a broad flat rim, (see fig. 39) also a smooth dry board, something larger than the dish, and formed into an octagon ; in the middle of this board make a round hole, that will hold a water-ball, so that one half be received in the dish, and the other half rise above the surface of the board ; nail this board upon the rim of the dish, and fix the ball in the middle, tying it fast with wire ; then glew your rockets in the grooves which are made round the edges of the board, laying them close to one another, so that successively taking fire from one another, they may keep the wheel in an equal rotation. You may add, if you please, on each side of the wheel, a few boxes, filled with crackers or cartouches, erected perpendicular, and also fix double and single crackers, following in a range, one after another, for two or three fires, or as many as the extent of the wheel will admit.

For your private fuzes, observe that you conduct one from the rocket, which is to be fixed to the composition of the ball in a channel.

Fill these channels with meal powder, and cover them close with paper : also lay a train of fuses of communication from the rockets to a cartouch, and from that to the rest. See fig. 40.

Lastly, when all is ready and covered, dip the whole machine into melted pitch, and secure it from the injury of the water ; the ball is fired first, and when lighted, you place it gently on the surface of the water, and then fire the rocket.

To try a fire-wheel, first weigh one of the rockets, tie it to a fell with cord, and according to that weight, fill little long bags full of sand, tying them likewise on the rest of the fells ; then hang the wheel on an iron pin, fire the rocket, and if it turns the wheel, then you may assure yourself it will be compleat when finished.

Wheels formed like stars, are to have their spokes fixed upright in the nave, like other wheels, only with grooves on one of the sides of each, where you glew the rockets ; at the bottom of each rocket is made a little hole, from whence the fire is conveyed through little pipes, filled with meal powder

der up to the next, and so round; then cover it with linen cloth, or paper, in the shape of a star, and place it on the iron axis.

Observe, that all the rockets used in fire-wheels have their necks tied close, leaving only a small conveyance from one rocket to another; the last of all must be well secured below, where you may place a strong report of corn-powder. See Fig. 40.

Charges for fire-flyers and wheels, of four, five, and six ounce rockets.

MEAL powder three pounds, saltpetre two pounds, charcoal five ounces, and sea-coal three ounces.

Meal powder fourteen ounces, saltpetre six ounces, charcoal three ounces and a half, brimstone three ounces, and sea-coal three ounces.

Meal powder fifteen ounces, saltpetre six ounces, brimstone three ounces, and charcoal three ounces.

Saltpetre five pounds, brimstone three quarters of a pound, charcoal one pound four ounces.

These charges are bored a little with a round bodkin.

Meal powder two pounds, sea-coal eight ounces, and charcoal ten ounces.

Meal powder three pounds, brimstone eight ounces, and charcoal ten ounces.

These charges may be used for tripple wheels, and must be bored one third with a bodkin.

For wheels of one pound rockets.

MEAL powder six pounds, saltpetre three pounds, brimstone one pound seven ounces, charcoal two pounds nine ounces, and tanners dust one ounce.

The bore must be an inch and an half.

For wheels of one and a half, and two pound rockets.

MEAL powder six pounds, saltpetre three pounds and a half, brimstone one pound and a half, charcoal two pounds three quarters, and saw-dust one ounce and a half.

The

The first rocket in the wheel is in length two diameters and a half of its orifice.

For wheels of three and four pound rockets.

MEAL powder nine pounds, saltpetre one pound and a half, brimstone one pound two ounces, and charcoal three pounds four ounces.

The first rocket is bored but one and a half of its diameter.

To make single and double CARTOUCHES, or BOXES, TUBES, STARS, SPARKS, &c.

WHEN some hundred boxes or cartouches are adjusted and fixed in machines of great fire-works, they afford among the towering rockets great delight to the spectators. These boxes are made either of wood, paste-board, or copper; and are charged and proportioned according to their strength, with the charge and composition that is designed for them. If made of wood they must fit exactly, and receive each other, so as to seem but one continual piece; and if paste-board, you must glue on a foot at bottom, of a hand high, to each of them: the inside of these machines must exactly fit and correspond with the outside of the cartouches themselves, and be so contrived as to slip into one another.

The engine, Fig. 42. is very proper for the construction of those boxes, one represents the bench, and the other the cylinders, upon which, (having greased them first over with soap) you fashion your boxes, just as you think proper, by pasting one thickness of paper upon another, and fixing a handle to the end of the cylinder.

Having formed them, put them to dry in a moderate heat, too great a heat will shrivel them up; when dry, take one after another off the cylinder, and immediately clap round wooden bottoms, the edges being first done over with glue, into them, and sprig them on the outside to make them secure.

The

The single boxes are to be changed in the following manner:

1. Put in some corn-powder.
2. Upon that charge fix a round paste-board, well fitted to the concave side of the box, which has five or six small holes, and is on both sides laid over with meal-powder tempered with brandy.
3. Put upon the paste-board a little meal-powder, and upon that well pierced crackers, so as to stand with their necks downwards: the principal rocket is put in the middle, with the neck downwards, open at both ends; so that being lighted above and burning down it may fire the rest of the crackers, which are blown up in the air by the corn-powder.
4. The empty spaces between the large fire-case and the crackers are carefully filled up, and the cartouch is stuffed at top with tow, or else with saw-dust boiled in saltpetre lee.
5. The cartouch is covered with a cap, which is glewed very closely thereon; and for the great case reaching out of the cartouch, make in the middle of the cap a hole, through which it is put, and close the opening by glewing some slips of paper round it. The fire-case is loose, covered with a paste-board cap.

Double boxes, or cartouches.

IN Fig. 43, is exhibited the construction of a case, called a double one; to enlarge on the description thereof seems to be needless, only observe, that the bottoms of the upper boxes serve for the covers of the lower, a hole being made through which the composition of the lower box is fired, after the upper rocket has forced away the empty box, which already has discharged its load. The upper box you cover as has been shewn above. If there are more than two cartouches upon one another, they are called Burning Tubes, which when fired shorten by degrees, the cartouches following one

one another till all are fired; some are intermixed with artificial globes, and several other fancies, which afford great pleasure to the spectators.

These boxes, or cartouches, are placed in long cases made for that purpose. The vacancies about the cartouches may be filled up with sand. See Fig. 44.

Another sort of fire tubes

ARE made of solid, hard, and dry wood, of what height and thickness you think proper; bore the middle of the wood one third or a quarter of its diameter, after which divide the whole height into equal parts, each exactly corresponding with the sky-rockets you design to fix upon them, but rather a small matter shorter; all these divisions are cut sloping downwards, except the uppermost, which must run out in a cylinder. On the rims of each of these divisions make a groove all round, of about a finger's breadth; in these grooves bore small holes, by which the fire may be conveyed through pipes from the cavity of the tube, to light the rockets that stand behind the paper cartouches, which must be made secure to the wood, lest they should fly up along with the rockets.

The construction of the hollow tube in this and other such like tubes is expressed in Fig. 45. A, the fire-stars and sparks, interspersed with corn-powder. B, a box filled with paper or crackers. C, a fire-ball or water-globe, which of them you please. D, another box filled with crackers. The hollows between these fires are filled up with corn-powder, to blow up the globes and boxes one after another.

The stars and sparks made use of on this occasion are prepared in the following manner.

Take of beaten saltpetre five pounds and a half, meal-powder two pounds four ounces, and brimstone one pound twelve ounces.

Meal-powder three pounds, saltpetre six pounds, brimstone one pound, camphire half an ounce, tanners bark two ounces, or else saw-dust; all finely sifted and moistened with linseed oil.

Meal-

Meal-powder one pound, saltpetre four pounds, brimstone half a pound, and pounded glass six ounces, moistened with linseed oil.

Saltpetre half a pound, brimstone two ounces, antimony one ounce, and meal-powder three ounces.

Saltpetre half a pound, brimstone three ounces, antimony one ounce, and iron file-dust half an ounce.

Saltpetre two pounds, meal-powder ten pounds, and brimstone one pound.

Saltpetre one pound, brimstone half a pound, meal-powder three ounces, and antimony one ounce.

Saltpetre one pound, sulphur two ounces, powder of yellow amber one ounce, crude antimony one ounce, meal-powder three ounces.

Sulphur two ounces and a half, saltpetre six ounces, fine meal-powder five ounces; frankincense in drops, mastick, mercury-sublimate, of each four ounces; white amber and camphire of each one ounce, antimony and orpiment of each half an ounce.

These ingredients being well beaten, and searfed thro' a searfer, must be sprinkled over with a little glue or gum water, and form'd into little balls, of the bigness of a small nut, then dry'd in the sun, or near a fire, and lay'd up in a dry place, to be ready, on occasion, for playing off with fire-works. When you use them, wrap them up in tow.

The following stars are of a more yellowish cast, inclining to white.

TAKE four ounces of gum-tragacant, or gum-arabick pounded and sifted through a fine sieve, camphire dissolved in brandy two ounces, saltpetre one pound, sulphur half a pound, coarse powder of glass four ounces, white amber one ounce and a half, orpiment two ounces; incorporate them, and make balls of them, as directed before.

Sparks are prepared thus.

TAKE saltpetre one ounce, ditto melted half an ounce, meal-powder half an ounce, and camphire two ounces.

X

ces

ces; having melted these things by themselves (when you use them) put together in an earthen pot, pour on them water of gum tragacant, or brandy that has gum arabick, or gum tragacant dissolv'd in it; that the whole may have the consistence of a pretty thick liquid; this done, take one ounce of lint, which before has been boil'd in brandy, vinegar, or saltpetre; when dry throw it into the composition, mix and stir it about, till it has soak'd it up; then roll them up in pills about the bigness of great pins-heads, and set them to dry, having first sprinkled them with meal-powder.

Some of these pyramidical tubes and fire-works, are now and then fired in large rooms, upon grand entertainments in miniature, wherein are employ'd odoriferous pills, and other ingredients, that have a fragrant smell; these pills are commonly composed of *storax calamita*, benjamin, gum juniper, of each two ounces; *olibanum*, mastick, frankincense, white-amber, yellow amber, and camphire, of each one ounce; saltpetre three ounces; lime-tree-coal four ounces; beat these ingredients very fine, pulverize and incorporate them together, and moisten it with rose-water, wherein before you have dissolv'd some gum-arabick or gum tragacant; you may form them into pills, and dry them in the sun, or before a fire.

Single tubes, or cases,

ARE only filled with compositions, and to the outside are fastened some crackers, serpents, or cartouches; these cases being generally round and uniform, like a cylinder, you are to trace out a winding line from the top to the bottom, on which cut holes to the depth of two or three inches. See Fig. 46. B and C. Into these holes contrive to fix paper-cases with wooden bottoms, wherein you may put any sort of rockets you please, as you see in A and E; but take care you provide little holes, to lead from the great tube to the corn-powder under these rockets.

Another fire tube is delineated Fig. 47. This is surrounded with cartouches, disposed in a serpentine order, like the first, which are glued and nailed as secure as possible; out of these
are

are dispersed great numbers of squibs ; as for the rest, they have nothing but what is common in others.

Another fire tube.

THE circumference of this cylinder is by a cord divided into a certain number of equal parts, and being brought into a polygonal figure, cutting away the convex part, it is brought into angles.

Then bore the plain sides with a number of holes perpendicular, so as to penetrate obliquely to the great boring in the middle : into these holes thrust crackers, squibs, or serpents. See fig. 48.

Fig. 49, exhibits a tube, whose length is six diameters of its thickness. The cylinder being divided round the rim into six parts, then subdividing each of those into seven parts, reserve one of them for the list, between each of which make channels, which being six in number, place little mortars of the same dimensions therein.

The mortars must be turned of wood ; bore the bottoms and add a chamber to them, as you see at E, each chamber must be one third or one half of the depth of the fluting, and the breadth one sixth only. These chambers are designed to hold corn powder.

Secure those mortars on the outside with strong paper cases, and nail them fast in the hollow channels, whose cavity they are to fit exactly ; their length may be doubled to their breadth ; each mortar must contain a globe made of paper, with a wooden bottom, and their chambers must be charged with corn powder.

These mortars fix in a spiral line, one only in each fluting, with iron stays, and bind the middle with an iron plate, fastened on each side of the interstices ; but before you fix the mortars, you must not forget to pierce little holes in the tube, and to fix the touch-holes of your mortars exactly upon them, priming both with meal-powder. Every thing relating to this may be plainly conceived in the figure, where A and B describe the mortars, and C the globe or cartouch.

X 2

Or

Of salvo's.

THESE, in fire-works, are a great number of strong iron reports fixed either in a post or plank, and with a fire discharged at once.

Charges for cartouches, or boxes.

MEAL powder six ounces, saltpetre one pound eight ounces, brimstone four ounces, and charcoal four ounces and a half.

Meal powder fourteen ounces, saltpetre five ounces, brimstone two ounces, and charcoal three ounces.

Meal powder one pound, saltpetre three quarters of a pound, brimstone four ounces and a half, tanners bark or saw-dust two ounces, and charcoal four ounces.

Charges for fire tubes.

MEAL powder six pounds, saltpetre four pounds, charcoal two pounds, rosin half a pound, tanners bark five ounces, moistened with a little linseed oil.

Meal powder three quarters of a pound, saltpetre four pounds, brimstone ten ounces, and saw-dust four ounces. This charge may be used dry.

Meal powder five pounds, saltpetre three pounds, charcoal one pound six ounces, rosin three quarters of a pound; not moistened.

A preservative for wood against fire.

THIS being a necessary article in the execution of fire-works, it will not be improper to set it down in this place.

Take brick-dust, ashes, and iron filings, of each an equal quantity; put them together in a pot, pour glue-water or size upon it, then put it near the fire, and when warm stir it together.

together. With this size wash over your wood-work, and when dry, repeat it, and it will be proof against fire.

The manner of preparing and making letters and names in fire-works.

BURNING letters may be represented after several methods.

Order a joiner to cut capital letters, of what length and breadth you please, or about two feet long, and three or four inches wide, and an inch and an half thick; hollow out of the body of the letters, a groove, a quarter of an inch deep, reserving for the edges of the letters a quarter or half an inch of wood. If you design to have the letters burnt of a blue fire, then make wicks of cotton or flax, according to the bigness and depth of the grooves in the letters, and draw them leisurely through melted brimstone, and place them in the grooves; brush them over with brandy, strew meal powder thereon, and again with brandy and thin dissolved gum-tragacant, and on that strew meal powder again; when dry, drive small tacks all round the edges of the grooves, and twist small wire to those tacks, that it may cross the letters, and keep the cotton or flax close therein; then lay over it brandy paste; strew over that meal powder, and at last glue over it a single paper.

If you would have the letters burn white, dissolve six pounds of saltpetre, and add to it a little corn-powder; in that dip your wicks of cotton or flax. You may instead thereof use dry touch-wood, which cut into pieces of an inch thick; put them in melted saltpetre over a fire, let them lay therein till the saltpetre is quite soaked through the wood, after which mix powdered saltpetre with good strong brandy; take some cotton and with a spatula, or your hands, work that, the saltpetre and brandy, together; then squeeze it out, strew the cotton over with powdered saltpetre, and thereof make wicks, having placed first the touchwood in the grooves, lay the wicks over that and the vacancies about it, and then proceed to make it tight and secure, as has been directed above. See fig. 40.

There is another method for burning letters without grooves, and this is done by boring small holes in the letters of about an inch distance, one from the other; the diameter

X 3

of

of those holes must not be above the eighth of an inch; into them put and glue cases, rammed with burning charges; but these letters do not burn so long as the others, except the charges are very long.

Another method for burning of letters is used, when they are formed by a smith of coarse wire, about a quarter of an inch thick; when this is done, get some cotton spun into match-thread, but not much twisted, to two yards of this take one pound of brimstone, six ounces of saltpetre, and two ounces of antimony, melt these ingredients in a kettle, first the brimstone by itself, and then the rest all together; when melted, put in the match-thread and stir it about, till it has drawn in all the matter; then take it out, and strew it over with meal powder, let it dry, and wind it about the white letters: fasten these upon a board, that has been well laid over with a preservative to keep it from firing. When you have lighted one letter, all the rest will take fire immediately.

Letters cut in a smooth board, which is made to slide in grooves of a chest are ordered thus: The lid of the box is made full of holes for dispersing the smoak of the lamps, or wax tapers, which are set behind, to illuminate the letters; behind the cut out-letters is pasted oil paper of various colours, which, when the lamps are lighted, has a fine effect. By these means, various changes may be made, in representing devices, names, coat of arms, &c. But this way is more practised on the stage in plays than in fire-works.

Charges for burning letters with cases.

MEAL powder six ounces, saltpetre one pound, mixed with Potolio oil.

Meal powder three quarters of a pound, saltpetre nine ounces, and brimstone three ounces, mixed up dry.

Meal powder five ounces, saltpetre seven ounces, brimstone three ounces, and file-dust half an ounce; moistened with linseed oil.

To

To order and preserve leading-fires, trains, and quick-matches.

FIRE-works being of various kinds and inventions, it is impossible to assign certain rules for their several performances. But to say something of what concerns a master's praise, it is observed, that great fire-works are not to be fired above once or twice at most; for it would not be deemed an artful performance to fire one cartouch after another; likewise the match pipes, the most preferable of which are either iron, lead, or wood, and should be strengthened or closely twisted round with the sinews of beasts, steeped in dissolved *feather-white*, and filled with slow charges, which ought to be well tried. Or else furnished with match-thread of *Stupinen*, dry and well prepared, and afterwards either joined to the grooves made in the boards, or only laid free from one work to another. The joinings of the pipes must be well closed and luted with potter's clay, so as to prevent the fire from breaking out; these pipes must also have little vent holes to give the fire air, or else it would be stifled, or burst the pipes; but these holes must be so contrived, that the flame may vent itself in the open air, and at some distance from the works, so as to prevent touching them.

All burning matches are to be as distant from the machines as possible, to prevent accidents.

A particular direction for conducting your trains and fuzes, cannot be given, because of the variety of postures, situations and contrivances of machinery; those rules already given will be sufficient for the ingenious; add to this the advantage a novice in this art may gather from the sufficient direction in this matter from the figures, which, with much care and industry, have been traced out for their information and benefit.

Charges for fuzes, or leading-matches.

MEAL-powder three ounces and a half, saltpetre four ounces, brimstone one ounce and three quarters, and charcoal one ounce and three quarters.

Meal-powder three ounces, saltpetre nine ounces, brimstone four ounces and a half, and charcoal half an ounce.

X 4

Meal-

Meal-powder four ounces, charcoal half an ounce, and coarse coal half an ounce.

Meal-powder half a part, saltpetre three parts, brimstone two parts, and charcoal one part; this last is very flow.

Of water-balls.

BALLS, in fire-works, are made of different fashions, some are globular, some oval, some conical, some cylindrical, others in the form of a pendant or drop.

The water-balls are commonly made of knitted cord-bags or of wood, those made of bags are shaped like ostriches eggs, and are

1. Filled with their proper charge.
2. The outside is dipped in glue, and wound about with hemp or flax, till it is a quarter of an inch thick thereon.
3. This ball is then coated over with cloth, and about the touch-hole is glued over with a piece of leather.
4. The touch-hole is bored with a gimlet, and stopped with a wooden peg.
5. At the bottom of the globe pierce a small hole thro' to the composition, in which fasten a small copper-pipe, furnished with a paper report, together with a leaden balance; glue the report fast to the ball, then dip the ball in melted pitch, open the touch-hole, and prime it with a quick burning charge.

These balls keep a long time under water, before they rise, and if a true balance is not observed in the lead, or the ball is overcharged, they will sink to the bottom and burn out, therefore you must well observe, that when a water-ball without the balance is two pounds weight, you must give it four, or four ounces and a half of lead, but if it weighs one pound and a half, balance it with three, or three ounces and a half.

Water-balls or globes made of wood, which swim and burn upon the water without any further effect, are of two sorts, *viz.* single and double, the single ones are made thus: have a hollow globe turned somewhat oblong, with a vent-hole, fill that with a good and approved charge, but not too close, prime the end with some meal-powder, then glew a stopple in the hole, which must be thrice as thick as the

the shell of the globe, in which beforehand the counterpoise is cast of lead; when dry, make a hole at top, large enough for a two ounce cracker to enter, through this, ram down the charge in the globe, and fill it quite full with the same composition; then glue it over with a paste-board: and lastly fix a small copper pipe through the stopple, having bored a hole through it for that purpose; to the pipe fasten a paper report, when this is done, dip the whole in pitch: these are called single water-globes. Both sort of globes are, for the better security, twisted and tied round with several rows of strong packthread.

Double water-globes are such, which after one is fired, discharges another. These have chambers at bottom, which are filled with gunpowder; on these put a cover of thick leather, which has several holes in the middle, and goes close to the side; on this strew meal powder, and place thereon a fire-globe, which is charged. Fig. 52, will demonstrate the construction with more ease than a long lesson; observe,

1. That the little chamber at bottom ought to be the fifth of the breadth of the whole globe, and that its height be one and a half thereof.

2. That the water-ball B should be encompassed with a water-ball composition, as you see by H.

3. The partition C is for this purpose, that when the powder in it shall have the fire conveyed to it through the pipes E F G, it may with more force blow up the ball, in the body of the first; this taking fire at the hole D, will burn upon the water for some time, and then, to the astonishment of the spectators, on a sudden, it will blow up the ball that was in it.

4. You must be very careful to secure the piece of leather or board that covers the little chamber, lest it should be blown up by the composition of the greater globe, before it is all burn'd out.

How

How to charge a water-globe with many crackers.

TAKE, for this purpose, a single water-globe, which may be round, or of an oval form, fill the same with the composition hereafter mentioned. Hollow the outside thereof in several places, to the size of your reports or crackers, which are to be fixed in them; to each of the crackers belongs a small copper tube, filled with meal powder, which are to be fitted to the small holes in the flutings, in the manner as expressed in the print, where fig. 53. A are the flutings, B the little holes for the fuzes, C the upper orifice for priming, D the hollow stopple, through which the ball is primed, E the form of the crackers, which are to be fixed in the flutings, F little fuzees belonging to them.

How to prepare a water-mortar, or water-pump, with several tubes.

TAKE seven wooden tubes, wrap them about with cloth that is either pitch'd or dipped in glue, twisting them round very tight with packthread. Their height, thickness, and diameter, you may order as you think proper, only allowing the middlemost a greater height than the rest; bind them together in one cylindrical body; to the bottom fix a round board with nails, and then with strong glue stop up all the crevices to prevent the air getting to the composition: this done, fill the tubes according to the order represented in fig. 54. First pour into each tube a little corn powder, about half an inch high; upon that put a water-ball A, upon that a flow composition; then again corn powder, upon which put a water-globe filled with squibs, as you see in B, on that again a flow composition, then corn powder; and then a light ball as may be seen in C, over this put a third time a flow composition on corn powder, as before, which you must cover with a wooden cap; on this fix running rockets, not too close, but to leave room enough between for a wooden case filled with a water composition; the remainder of the tube fill with a flow charge, and close it up. Your tubes being all filled in this manner, get a square or round piece of plank, with a round hole in the middle, large enough to receive the ends of all

all the tubes, which cover close, to preserve the powder and composition from being wet; this float-board is marked with the letter D, fig. 55. Thus prepared, dip it in a quantity of tar, or melted pitch, then put the rocket E, or a small wooden tube filled with a strong composition that will burn on the water into the orifice of the middle tube; the composition of which should be more slow than of the rest.

If you would have the tubes take fire all round at once, you must pierce the sides of the great one with small holes, corresponding with those in each of the other tubes; by this means the fire may be conveyed to all of them at once, and consume them equally and at one time; but if you would have them burn one after another, you must close them well up with paste-board, and to each tube fix a fuzee of communication, filled with meal powder, or a slow composition, through which the fire may be conveyed from the bottom of that which is consumed to the orifice of that next to it, and so on successively to such as have not been fired.

How to charge a large water-globe with several little ones, and with crackers.

HAVE a wooden cylinder made, let the orifice thereof be at least one foot diameter, and its height one and a half; let there be a lodge or chamber at bottom to hold the powder, which must be confined therein by a tampion or stopple joined to a round board, fitted exactly to the inside of the globe, through the middle of the stopple must pass an iron tube filled with meal powder; then prepare six water-balls, or more, if you think fit, so that when all are set together in the circumference of the globe, they may fill up that circle; each of these balls must be provided with an iron fuzee in its orifice, filled with meal powder. Having charged the chamber of the globe with corn powder, let down the fore-mentioned board with the stopple upon it, then range the six water-balls, cover them with another round board, that has six little round holes, corresponding with the six iron fuzees of the balls, and which must a little surmount it. This last board spread over with meal and corn-powder mix'd together, and upon it you place as many rockets as the globe can hold: in the midst of these you fix a large rocket, into whose orifice

orifice the iron tube may enter, which is the same you see in E, Fig. 56.

This tube must have holes drill'd all round the plane of the aforesaid partition or board, to the end that the fire having a communication through them, it may reach the running rockets, and at the same time fire the water-balls, whose tubes rise out of the board, and from thence, after having penetrated down to the chamber below, it may blow up the whole into the air, and make a great noise. See the figure, where A points out the six water-balls, B the great rocket in the middle of the running ones, C the chamber for the powder, D, a communication, or the iron pipe, to convey the fire to the paper cracker, F the globe, which having been adjusted after the manner directed, cover it close round, dip it in tar, to preserve it from the water.

To prepare the water bee-hive, or bee-swarm, both single and double.

THE single bee-swarm is thus prepared. Have an oblong globe turn'd, whose length is two diameters of its breadth, or proportioned to the height of your rounding rockets, which place round the wooden tube marked with A; this must be of an equal height with the globe, and be fill'd with a composition of three parts of powder, two of saltpetre and one of brimstone; at the lower end of the globe fix a paper cracker C; the letter D is a counterpoise of lead, through which you convey a little pipe or fuzee, to communicate with the charge in the wooden tube; at top fix a round board for a balance; F two little holes which convey the fire to the charge for blowing up the rockets. See Fig. 57.

How to prepare a water-globe on the outside with running-rockets.

GET a wooden globe perfectly round and hollow, bore on the outside several cavities, sufficient to receive running-rockets, leaving a quarter of an inch between the extremities of them, and the composition within the ball; then bore the wood, left between each, with a small gimlet, fill them with meal-powder, then put in your rockets; close the top of the globe with a wooden cylinder, that has a hollow

hollow top, with a touch-hole to receive the priming, the bottom stop with a stopple, which likewise has a conveyance to the cracker that is commonly fix'd beneath it; between which and the stopple fix also a leaden counterpoise, to keep the whole upright in the water. See Fig. 58.

To prepare water-globes with single or double ascending rockets.

FOR the first sort have a globe turned with a tube in the middle, half its diameter wide, leaving two inches for the placing of solid wood at the bottom; round this tube bore holes for small rockets thereon, after which you burn, with a red hot wire or small iron, touch-holes out of the large tubes into the little ones, then fill the globe with the following composition, *viz.*

Two pounds of saltpetre, eight ounces of brimstone, eight ounces of meal-powder, twelve ounces of saw-duft, this done, close the top with a stopple which has a touch-hole in the middle, then put a good deal of meal-powder in the small tubes, up to the touch-holes; and after you have placed your rockets upon that, fill the vacancy round with a little corn-powder, glue over them paper-caps, then dip the globe into pitch, but not over the paper covering; fix a counterpoise at bottom, and when the fire has burned half way or further in the large tube it will communicate through the touch-holes, and discharge all the rockets at once.

The second sort is done after the same manner, only the middle tube is not bored so wide, because of giving more room for two rows of small tubes round it; the first row next to the tube is bored a little below the middle, the second almost near to the end thereof; the touch-holes for the former are burnt from the inside of the great tube, and those of the latter from the outside hole are closed again with a wooden pin: in the large tube you may lodge a strong report of iron, charged with corn-powder, having a touch-hole left at top. See Fig. 59, 60.

Charges for single water-globes.

CORN-powder half a pound, saltpetre sixteen pounds, brimstone four pounds, ivory shavings four ounces, saw-duft boiled in saltpetre-lee four pounds.

Meal-

Meal-powder one pound, saltpetre six pounds, brimstone three pounds, iron filings two pounds, and rosin half a pound.

Meal-powder four pounds, saltpetre twenty-four pounds, brimstone twelve pounds, saw-dust eight pounds, powdered glass half a pound, and camphire half a pound.

Corn-powder one ounce, saltpetre twelve ounces, brimstone four ounces, and saw-dust three ounces.

Saltpetre twelve ounces brimstone four ounces, saw-dust two ounces, melted stuff three quarters; this must be rammed in tight.

Meal-powder one pound four ounces, saltpetre one pound eight ounces, brimstone nine ounces, saw-dust five ounces, pounded glass one ounce, melted stuff four ounces, mix them together with a little linseed oil.

Meal-powder eight ounces, saltpetre five pounds, brimstone two pounds, copper filings eight ounces and a half, and coarse coal-dust eight ounces and a half.

Saltpetre eight ounces, brimstone three ounces, saw-dust one ounce, and tanners-bark two ounces.

Saltpetre six pounds twelve ounces, brimstone two pounds fourteen ounces, melted stuff half a pound, saw-dust one pound, coarse coal-dust one pound, and pounded glass one pound, mix'd up and moistened with vinegar.

Saltpetre two pounds twelve ounces, brimstone two pounds six ounces, melted stuff four ounces, saw-dust eight ounces, charcoal one ounce and a half, and pounded glass three quarters of an ounce, moistened with linseed oil, and mix'd up with a little corn-powder.

Charges for double water-globes.

Saltpetre four pound six ounces, brimstone one pound four ounces, saw-dust half a pound, and coarse coal-dust six ounces, moistened with a little vinegar or linseed oil.

Meal-powder one pound four ounces, brimstone four ounces, and charcoal two ounces, moistened with *Petroleum* oil.

Saltpetre three pounds, brimstone a quarter of a pound, and saw-dust boiled in saltpetre ten ounces, moistened a little.

Charges.

Charges for bee-swarms.

MEAL powder thirteen ounces and a half, saltpetre six ounces, brimstone two ounces and a half, fine charcoal three ounces, coarse charcoal one ounce, and fine saw-dust three ounces.

Meal powder three quarters of a pound, saltpetre six ounces, brimstone three ounces and a half, fine charcoal four ounces, and coarse charcoal two ounces and a half.

Meal powder four parts, saltpetre eight parts, brimstone two parts, coarse charcoal two parts, and fine charcoal one part.

Odoriferous, or perfumed Water balls.

HAVE balls turned about the size of large walnuts, fill them with any of the compositions specified below; after they are filled and ready, light and put them into water. This is generally done in a large room or hall, at grand entertainments.

The composition for them are as follows:

Saltpetre four ounces, *storax calamita*, one ounce, frankincense one ounce, mastic one ounce, amber half an ounce, civet half an ounce, saw dust of juniper two ounces, saw dust of cypress two ounces, and oil of spike one ounce.

Saltpetre two ounces, flower of sulphur one ounce, camphire half an ounce, raspings of yellow amber half an ounce, coal of lime-tree wood one ounce, flower of benjamin, or *assa odorata* half an ounce; let those which are to be powdered, be done very fine; then mix them together as usual.

Saltpetre two ounces, myrrh four ounces, frankincense three ounces, amber three ounces, mastic one ounce, camphire half an ounce, rosin one ounce, boiled saw-dust one ounce, lime-tree coals half an ounce, bees-wax half an ounce; mix them up with a little oil of juniper.

Saltpetre one ounce, myrrh four ounces, frankincense two ounces and a half, amber two ounces, mother of pearl four ounces, melted stuff half an ounce, and rosin half an ounce; mix them up with oil of roses.

Meal

Meal-powder three ounces, saltpetre twelve ounces, frankincense one ounce, myrrh half an ounce, and charcoal three ounces, mixed with oil of spike.

The manner of preparing the melted stuff.

MELT twenty-four pounds of sulphur in a shallow earthen pan, over a clear fire, and as it melts, fling in sixteen pounds of saltpetre; stir them well together with an iron spatula; as soon as they are melted take it off the fire, and add to it eight pounds of corn-powder; mix it well together, and being cooled, pour out this composition upon a polished marble, or metal-plates, and then divide it into pieces about the size of a walnut. This composition is chiefly used in military fire-works, and not for those I am treating of; but for those fire-works which are only for pleasure: it is distinguished by warm and cold melted stuff, and is prepared in the following manner.

Take for the first sort half a pound of saltpetre, grind among it three quarters of an ounce of antimony, till one cannot be distinguished from the other; then melt one pound and a half of brimstone, put the mixed saltpetre and antimony to it, and mix them well together; this done put it warm into a wooden mould of two pieces, which should be well greased on the inside: this stuff you break afterwards in bigger or lesser pieces; it is, on account of its clear fire, used to imitate stars.

The manner of preparing the cold melted stuff.

GRIND the above ingredients, or eight ounces of meal-powder, four ounces of saltpetre, three ounces of brimstone, and one ounce of coal-dust, together, till all is of one colour; this done, moisten that stuff with the white of eggs, gum-water, or size, and make thereof a stiff dough; then strew on a smooth board some meal-powder, roll the dough upon that a quarter of an inch thick, strew again meal-powder upon it, then cut it in square pieces, and let them dry; or else form small balls of it, of the size of a small nut, or larger; then roll them in meal-powder and put them up to dry.

To

To prepare a globe which burns like a star, and leaps about both on land and water.

CAUSE a globe to be turned of dry wood, whose diameter is the length of a half pound or a pound rocket : divide this globe into two equal parts, in the middle of one of the half globes, on the inside, make a cavity, deep, long, and wide enough to hold three or four rockets or crackers, so that the other half of the globe may be easily and closely fitted upon them ; after this take three crackers, one with strong reports and two without any, place them so into the hollow, that the head of the one may lay to the other's neck, and be so ordered that as soon as the one is spent, the other may take fire and force the globe back, and thus alternately from one to the other till it comes to the report, which finishes. Care must be taken that the fire passes not from the first to the next cracker, before it has quite consumed the first ; but as I have given a caution in the article about rockets that run on a cord, the same may be observed here.

Having taken care to fix the rockets, cover them with the other half globe, and join them firmly with strong pasted paper.

To charge globes, which leap on land, with iron and paper crackers.

TAKE a hollow wooden globe, which has a touch-hole at the top, in the form of a small cylinder ; fill it with an aquatic composition quite full ; then bore into the charge five or six holes about half an inch wide, in which put iron petards or crackers, which run tapering ; provide them at the lower end with a small touch-hole, and cover the top with a tin-plate, in which there is four holes, which you must close up with wads of paper or tow, after you have filled them with the best corn-powder : and when you fire them on even ground, you will see them leap as often as a cracker goes off. See Fig. 61.

The other sort is not much unlike the first, except that to this you add a certain number of crackers, which are disposed as you may observe in Fig. 62. A the crackers, B the touch-hole.

Y

How

How the globes, discharg'd out of a mortar, are made and ordered.

FIRST find the mouth of the mortar, and divide it in twelve parts; then have a globe turn'd of wood, which is two diameters of the mouth high; divide the diameter in six equal parts, and let the height between A and C be the diameter of the globe, the radius of the semi-circle C I, shall be one sixth, or half the height of the globe, the thickness of the wood H I, shall be $\frac{1}{12}$ of the above diameter, and the thickness of the cover of the diameter of the globe; the diameter of the cavity of the globe five sixths of its whole diameter; the height of the priming chamber B F shall be one sixth and a half of the diameter, but its breadth only one sixth; the diameter of the touch-hole is one fourth or one sixth of that of the chamber: for the better understanding these directions, see Fig. 63.

The manner of filling these globes is thus.

Take hollow canes or common reeds, cut them into lengths to fit the cavity of the globe, and fill them with a weak composition made of three parts meal powder, two of coal, and one of brimstone, moisten'd with a little linseed oil; excepting the lower ends of them, which rest upon the bottom of the globe, which must have meal powder only, moisten'd likewise with the same oil; or sprinkled over with brandy and dry'd: the bottom of the globe cover with meal-powder mix'd with an equal quantity of corn-powder; the reed being fill'd in this manner; set as many of them upright in the cavity of the globe, as it will contain; then cover it well at top; and wrap it up with a cloth dip'd in glue, the priming must be of the same composition with the reeds.

The globes represented, N^o 97 and 98, are contriv'd like the above, only the first of these is fill'd with running rockets, and the last with crackers, stars, and sparks, interspersed with meal-powder, and put promiscuously over the crackers; the figures are so plain, that I need not give any further explanation.

N^o 99 is the representation of a globe, which plainly shews its construction: the great globe which contains the lesser is the same as described above; for it is charged with running rockets,

rockets, as that of 97. However with this difference, that this is lined but with single rockets, and the other is filled up with them. In the midst of these rockets fix a globe in a cylindrical form, with a flat bottom, and a chamber and touch-hole at A, the cavity of this inner globe is filled with iron crackers, and covered with a flat covering: the priming chamber fill with the same composition as has been directed for the above globes; the fuzees must be filled with good meal-powder.

N^o 100 shews another sort of globe, which is prepared thus. First get a wooden globe, in the middle whereof fix a mortar with a little chamber for powder; round which form a lodge, for ranging paper tubes; this lodge must have a groove or channel, fill'd with meal-powder, to convey the fire all round; this done, put a globe into the mortar, fill'd with running rockets, crackers, reeds, or stars and sparks; and having placed your paper tubes fill'd with running rockets round the groove, cover them about with strong pasted paper and cloth dipp'd in glue, as has been directed. The figure of this globe will illustrate the description, A shews the mortar, B the touch-hole, C the priming chamber, D the priming of the mortar, E in the other figure represents the order in which the paper tubes are placed upon the groove.

To form letters, and all sorts of figures which may be represented in the open air in a dark night.

PROVIDE a wooden globe of the same form, height, breadth and thickness, as those already described, only the priming chamber must be the height and breadth of one sixth of the diameter of the whole globe. Besides this chamber there must be another B, for corn-powder, the height and breadth must be equal to $\frac{1}{8}$ of the diameter of the globe, the vent-hole must be a quarter of the powder or priming-chamber; you must also have another globe in a cylindrical form, the bottom of which must be rounded on the outside, as may be observed in the same figure by F, the cover must be let a little into the inner surface of the cover of the great globe, to keep it firm, placing this lesser globe perpendicularly over the chamber, which is filled with corn-powder.

Y 2

Fill

Fill the cavity of the little globe with running rockets, stars and sparks, as may be seen in the figure at the bottom of the large globe; having furnished the vent-hole with meal, and the chamber with corn powder, put about the small globe the same composition, mix'd promiscuously together, and on this fit a flat wooden ring, very tight to the globe, in which bore holes, as you see in Fig. 101. Your globe being thus prepared, take two long thin slips of whale-bone, which bend easily without breaking; join them together parallel, so as to have their bendings opposite to each other, and make a straight piece; take two of these long pieces and join them, as is seen in A, by two shorter pieces at both ends, so as to make a right angled parallelogram, RSTU; within this frame form your letters, either of wire or whale-bone, placing each about a hand's breadth from the other; and having fix'd your letters, wrap them neatly round in quick tow from one end to the other, taking care that none of it entangle about the frame, lest when the letters burn, their flame should be confounded in one another; then steep your letters in brandy, wherein before you have dissolv'd some gum-arabick, and in drying, strew them over with meal-powder; if you would have your letters descend perpendicular to the horizon, you must fasten two small weights to your frame, at T and U, but if parallel to the plane of the horizon, you must have a weight at each corner; having order'd it thus, bend it round to go in the inner circumference of the great globe, and let it rest perpendicular on the wooden ring, and fill the empty places about the letters with meal-powder; then cover it up; and prepare the globe fit for the mortar, as usual; it will have a delightful effect.

To prepare the quick tow.

TAKE either flax, hemp, or cotton, of two or three strands, twist them slightly and put them into a clean glaz'd earthen pan, pour on them good white-wine-vinegar four parts, urine two parts, brandy one part, purified saltpetre one part, meal-powder one part, boil it all together over a quick fire, till

till all the moisture is evaporated; then strew meal-powder on an even board, and roll your match therein, then let it dry either in the sun or shade. This sort of match burns and consumes very quick, but if you would have it burn slower, make the liquor weaker, boiling the match in saltpetre and vinegar only, and strewing meal-powder in it, let it dry.

Another sort of match is made by some which is not twisted at all, but only dip'd in brandy, for some hours, then powdered over with meal-powder and dry'd; some dissolve a little gum-arabic or tragacant in the brandy, this will make it stick the better to any thing.

To prepare the light balls, proper to be used at bon-fires.

TAKE two pounds of crude-antimony, four pounds of brimstone, four pounds of rosin and four pounds of coal, and half a pound of pitch; having powered all these ingredients, put them into a kettle or glaz'd earthen pan, over a coal fire, and let it melt; then throw as much hemp, or flax into it as may be sufficient to soak it up; then take it off the fire, and whilst it is cooling, form it into balls.

You may wrap them up in tow, and put them either into rockets or globes.

To prepare the paste for stars and sparks.

TAKE five ounces and a half of meal-powder, one pound twelve ounces of brimstone. *Or,*

Take three pounds of meal-powder, six pounds of saltpetre, one pound of brimstone, two pounds of camphire, and two ounces of tanner's bark or saw-dust. Moisten all these ingredients with linseed oil.

Take meal-powder one pound, saltpetre four pounds, brimstone half a pound, and powder'd glass six ounces; moistened with a little linseed oil.

Saltpetre half a pound, brimstone two ounces, antimony one ounce, and meal powder three ounces.

Saltpetre half a pound, brimstone three ounces, antimony one ounce, and iron file-dust half an ounce.

Saltpetre two pounds, meal-powder ten pounds, and brimstone one pound,

Y 3

Saltpetre

Saltpetre one pound, brimstone half a pound, meal-powder three ounces, and antimony one ounce.

Having mixed and prepared your ingredients, boil some flax in saltpetre lee and camphire, then cut it small and mix it up with any of the above compositions, which must be moistened with either the white of eggs, gum, or size: form this into little balls of the size of a hazel-nut, strew them over with meal-powder and let them dry.

To cause the stars to burn very bright, make your composition of one ounce and three quarters of saltpetre, three quarters of an ounce of brimstone, and a quarter of an ounce of powder.

Saltpetre two pounds, brimstone fourteen pounds and a half, and meal-powder six ounces.

The paste or melted stuff above mentioned, is also made use of for the same purpose, wrapt in tow.

To project globes from a mortar, and the quantity of powder required for that purpose.

THE globes being of wood, it is requisite that the charges for them should be agreeable to their substance, for which end they are first weighed, allowing for each pound of its weight a quarter of an ounce of gun powder. For example, if your globe weighs forty pounds, you must, to discharge it, allow ten ounces of powder.

The charge is thus performed; put the powder into the chamber of the mortar, and cover it with straw, hay, hemp, or flax, so as to fill it quite full; or if the chamber of the mortar be too big, get one turned of wood equal in height and breadth to the chamber of the mortar, that contains the charge of powder required; pierce this with a red hot wire, from the bottom of the wood to the centre of the bottom of the chamber in it, not perpendicular but slanting, as from *c* to *b* in Fig. A. The place, where the touch-hole begins, must be marked, so that you may turn it to correspond with the touch-hole of the mortar. When you would load your mortar, cover the bottom of the chamber with a little meal and corn-powder, mix'd together, and upon that put the wooden

wooden chamber, in which is the powder required to discharge the globe; then fix the touch-hole of the globe exactly upon the chamber, wrapping it in hemp, &c. to make it stand upright.

The mortars contrived on purpose for globes are more commodious, and one is more certain in projecting them: these are cast as follows: the length of the mortar with the chamber without the bottom, is two diameters of the mouth; the bottom is one fifth thick; the chamber is half the diameter of the mouth long, and a quarter wide, oval at bottom; the sides are an eighth of the diameter of the mouth thick, which is encreased at bottom to a third; the thickness about the chamber is a fourth part.

Some prepare these balls with saltpetre four pounds, brimstone one pound and a half, powder half a pound, antimony six ounces, and charcoal half an ounce.

Saltpetre four pounds, brimstone three pounds, camphire a quarter of a pound, and powder half a pound.

Y 4

PART

PART XIV.

The art of dying SILKS, WORSTEDS, COTTONS, &c. of various colours.

THE art of dying in colours is of great antiquity, as appears both from sacred and profane history; but who were the first inventors thereof, is uncertain; however, for the generality it is conjectured that like many others it had its first birth by accident: the juices of certain fruits, leaves, &c. accidentally crushed, are supposed to have given the first hint. Purple, an animal juice, found in a muscle, was first discovered to be of a tinging quality, by a dog's catching one of the purple-fishes among the rocks, which in eating stained his mouth with that precious colour: this colour was in so high esteem among the Romans, that none but their emperors were suffered to wear it. I could give the curious a long historical and speculative account concerning this ingenious art, but being a subject not suitable to the intent of this work, I shall only inform my readers of the practice thereof, in as concise and plain a manner as possible. My first lesson is:

How to dye silk or worsted of a fine carnation colour.

FIRST take to each pound of silk, four handfuls of wheaten bran, put it in two pails of water, boil it, pour it into a tub, and let it stand all night; then take half the quantity of that water, put into it $\frac{1}{2}$ a pound of allum, $\frac{1}{4}$ of a pound of red tartar, beaten to a fine powder, and $\frac{1}{2}$ an ounce of fine powdered curcumi; boil them together, and stir them well about with a stick; after they have boiled for a quarter of an hour, take the kettle off the fire, put in the silk, and cover the kettle close to prevent the steam from flying out; leave it thus for three hours, then rinse your silk in cold water,

water, beat and wring it on a wooden pin, and hang it up to dry.

Then take $\frac{1}{4}$ of a pound of gall-nuts, beat them fine, and put the powder thereof into a pail of river-water; boil it, for one hour; then take off the kettle, and when you can bear your hand therein, put in your silk, and let it lay therein an hour, then take it out and hang it up to dry. When the silk is dry, and you would dye it of a crimson colour, weigh to each pound of silk $\frac{3}{4}$ of an ounce of cochineal, which beat to a fine powder, and sift it through a fine hair sieve; then put it in the pail with the remaining lee, and having mix'd it well, pour it into a kettle, and when it boils, cover it well to prevent any dust coming to it; after you have put in $\frac{3}{4}$ of a pound, and two ounces and a half of tartar, both finely powdered, let it boil for a $\frac{1}{4}$ of an hour; then take it off the fire, let it cool a little and put in the silk, stir it well with a stick to prevent its being clouded, and when cool wring it out. If the colour is not deep enough, hang the kettle again over the fire, and when it has boiled and is grown lukewarm again, repeat the stirring of the silk therein; then hang it upon a wooden pin which is fastened in a post, wring and beat it with a stick; after this rinse the dyed silk in hot lee, wherein to one pound of silk, you have dissolved half an ounce of *Newcastle* soap, afterwards rinse it in cold water. Hang the skains of raw-silk on a wooden pin, putting a little hand-stick to the bottom part, and thus having worked, wrung and beat it round, you must hang it up to dry.

Another method to dye silk of a crimson red.

TAKE of good *Roman* allum half an ounce, tartar one ounce, spirit of vitriol quarter of an ounce, and put them pulverized into a pewter kettle, and pour as much water on them as is sufficient for the quantity of half an ounce of the silk you purpose to dye; when it is ready to boil, put in the silk which before you must boil in bran; boil it for an hour or more, then wring it out, and put to the liquor half an ounce of cochineal finely powdered, and 60 drops of spirit of vitriol; when

when ready to boil, put in the filk again, and let it soak for four hours; then take clean water, drop into it a little spirit of vitriol, rinse therein the filk, take it out again, and dry it on sticks in the shade. This will be a high colour, but if you would have it of a deep crimson, you take, instead of spirit of vitriol, spirit of sal-armoniac, to rinse your filk in.

General observations in dying crimson, scarlet, or purple.

1. **Y**OUR copper or kettle must be of good pewter, quite clean and free from any soil or grease.
2. The prepared tartar must be put in when the water is luke-warm.
3. If you intend to dye woollen or worsted yarn, you may put it in the first boiling, and let it boil for two hours.
4. When boil'd take it out, rinse it, clean the kettle, and put in the water for the second boiling.
5. This second boiling is performed in the same manner as the first; then put in cochineal finely powdered, when it boils hard, stir it well about.
6. Then the filk, which before has been washed and cleaned in the first lee, is put in on a winch, which is continually turned about, in order to prevent the colours from fixing in clouds.
7. When the colour is to your mind, take it out of the copper, rinse it clean, and hang it up in a room or a shady place, where it may be free from dust.
8. You must observe, that when the aqua-fortis is put into the second boiling, it causes a coarse froth to swim at top, which you must carefully take off.

Now

How to dissolve the pewter for dyer's aqua-fortis.

TAKE fine pewter, pour first a little clear water over it, then pour on the aqua-fortis, which will dissolve it. The solution is of a whey or milk colour, temper it by adding more aqua-fortis, till it is clear. The common proportion is, to one ounce of aqua-fortis add a quarter of an ounce of pewter.

To dye a crimson with orchal.

PUT clean water into the copper, and to each pound of filk take 12 ounces of orchal: in this turn your filk and wring it out; then dissolve to each pound of filk $\frac{1}{4}$ of a pound of allum, and as much of white arsenic; in this liquor put the filk all night to soak; then wring it out; this done, take to each pound of filk, two ounces of cochineal, two ounces of galls, two ounces of gum, with a little curcuma: in this boil the filk for two hours; then put in a little zepsie, let it soak all night, and in the morning rinse it out.

To dye a violet colour.

FIRST boil your filk in bran and allum, as has been shewn above; then clean your copper, and with clean water, put to each pound of filk, one ounce of galls, one ounce and a half of cochineal finely powdered, and one ounce of gum-arabick, boil it together like the crimson red; leave it all night, and the next morning take out your filk, and rinse it in fair water.

To dye worsted, stuff, or yarn of a crimson colour.

TAKE to each pound of worsted, two ounces of allum, two ounces of white tartar, two ounces of aqua-fortis, half an ounce of pewter, quarter of a pound of madder, and a quarter of a pound of logwood, put them together in fair water, boiling the worsted therein for a considerable time; then take it out of the copper, and when cool, rinse it in clean water: then boil it again, and put to each pound of worsted, quarter of a pound of logwood.

Another

Another method.

TAKE to eight pounds of worsted, six gallons of water, and eight handfals of wheaten bran; let them stand all night to settle, in the morning pour it clear off, and filtrate it; take thereof half the quantity, adding as much clear water to it; boil it up, and put into it one pound of allum, and half a pound of tartar; then put in the worsted, and let it boil for two hours, stirring it up and down all the while it is boiling with a stick. Then boil the other half part of your bran-water, mixing it with the same quantity of fair water as before; when it boils, put into it four ounces of cochineal, two ounces of fine powdered tartar; stir it well about, and when it has boiled for a little while, put in your stuffs: keep stirring it from one end of the copper to the other with a stick, or turn it on a winch, till you see the colour is to your mind, then take it out of the copper, let it cool, and rinse it in fair water.

Another for silk.

TAKE to each pound of silk, a quarter of a pound of fernambuca, boil it up, and strain it through a sieve into a tub, and pour water to it, till it is just luke-warm: in this turn your silk, which before has been prepared as has been directed, and when all the strength is drawn out, rinse, wring and dry it.

Another fine carnation.

TAKE to each pound of silk, after it is rinsed and dried, four pounds of safflower, put the safflower in a bag, and wash it in clean water, till the water comes clear from it; then take the safflower out of the bag, press it between your hands, and rub it asunder in a clean tub; take to each pound of silk, four ounces of pot-ashes, work it well together with the safflower, divide it into two parts, pour one part thereof into a close sack, that will keep the pot-ashes from coming out, otherwise it will make the silk speckled, and pour clear water over, to draw the strength out of the saff-

safflower; then take to each pound of silk, a quarter of a pint of lemon juice; divide that also into two parts, and put each to the two quantities of safflower, hang your silk well dried on clean sticks: and dip it in the first part of the liquor continually for an hour; then wring it well out, and hang it again on sticks; having prepared the other part of the safflower as you did the first, dip it therein as before for the space of an hour; then wring it well and hang it up to dry in the shade, and you will have a fine colour.

A carnation for woollen.

TAKE four ounces of ceruse, three ounces and a half of arsenic, one pound of burnt tartar, one pound of allum; boil your stuffs with those ingredients for two hours; then take it out, and hang it up; the next morning make a dye of two pounds of good madder, a quarter of a pound of orlean, two ounces of curcumi, and three ounces of aquafortis.

To dye a carnation on silk, or cotton, with fernambuca.

TAKE three pounds of allum, three ounces of arsenic, four ounces of ceruse; boil your silk or cotton therein for an hour; then take it out and rinse it in fair water; after which make a lee of eight pounds of madder, and two ounces of sal-armoniac, soak the silk or cotton therein all night, then boil it a little in fair water, and put into it one ounce of pot-ashes; then pour in some of the lee, and every time you pour, the colour will grow the deeper, so that you may bring it to what degree or shape you please.

Another method.

TAKE to one pound of silk, cotton, or yarn, one ounce of tartar, and half an ounce of white starch; boil them together in fair water; then put in one quarter of an ounce of cochineal, a quarter of an ounce of starch, and a quarter of an ounce of pewter, dissolved in half an ounce of aquafortis, and mixed with fair water; when the water with the starch and tartar has boiled for some time, supply it with the cochineal and

and the above aqua-fortis ; put in your silk, or whatever you have a mind to dye, and you will have it of a fine colour.

Another method.

TAKE one ounce of tartar, starch and lemon juice, of each half an ounce, and cream of tartar a quarter of an ounce ; boil them together in fair water, adding a quarter of an ounce of curcumi : put in half an ounce of cochineal, and a little while after one ounce of aqua-fortis, in which you have dissolved a quarter of an ounce of pewter, and then put in your silk.

To dye yarn or linen of a lasting violet colour.

TAKE one pound of tartar, half a pound of allum, two ounces of fernambuca, and half an ounce of saltpetre ; boil them together, then let them cool a little, and put in your yarn ; let it soak for four hours, keeping the dye hot but not boiling, after which rinse and dry it.

How to prepare or set a blue vat for dying.

HEAT soft water in a kettle or copper, fling four or five handfals of wheaten bran, together with four pound of pot-ashes into it, when that is dissolved boil it for an hour, and then add four pounds of madder ; with this boil it for an hour longer, then pour the water into the vat, fill it not full by the height of a foot, and then cover your vat ; then set it with indigo and woad, of each six pounds, and two pounds of pot-ashes ; put this into a small kettle in warm water, set it on a slow fire, and let it boil gently for half an hour, stirring it all the while ; then pour that to the other liquors already in the vat.

To set a vat with indigo only, you must boil the first lee with pot-ashes, four or five handfals of bran, and half or three quarters of a pound of madder ; this you boil a quarter of an hour, and when settled it will be fit for use. Then grind your indigo in a copper bowl, with an iron smooth ball very fine, pouring on some of the lee, and mixing it together ; when settled, pour the clear into the blue vat, and on the
fedi-

sediment of the indigo, pour again some of the lee; this you should repeat till you see the blue tincture is extracted clearly from it.

It is to be observed, that the madder must be but sparingly used, for it only alters the colour, and makes it of a violet blue; which, if you design to have, cochineal is the fitter for. The mix'd colours in blue are the following: dark blue, deep blue, high blue, sky blue, pale blue, dead blue, and whitish blue.

By mixing of blue and crimson, is produced purple, columbine, amaranth, and violet colours; also from those mixtures may be drawn the pearl, silver, gridelin, &c. colours.

From a middling blue and crimson are produced the following colours, viz. the pansy, brown grey, and deep brown.

Care must be taken that in setting the blue vat, you do not overboil the lee, by which the colour becomes muddy and changeable; be also sparing with the pot-ashes, for too much thereof gives the blue a greenish and false hue; but experience is the best instructor in this.

Another direction how to set a blue vat; together with several observations in the management thereof, both for silk and worsted.

TAKE half a bushel of clean beech ashes, well sifted, of this make a lee with three pails of river or rain-water, pour it into a tub, and put in two handfuls of wheaten bran, two ounces of madder, two ounces of white tartar finely powdered, one pound of pot-ashes, half a pound of indigo pounded; stir it all well together once every 12 hours for 14 days successively, till the liquid appears green on your fingers, and it is fit to dye; however, when ready, stir it every morning, and when you have done, cover it.

When you are going to dye silk, first wash the silk in a fresh warm lee, wring it out, and dip it into the vat; you may dye it what shade you please, by holding it longer or shorter in the dye.

When the colour is to your mind, wring the silk, and having another tub ready at hand, with a clear lee, rinse therein your silk, then wash and beat it in fair water, and hang it up to dry.

When

When the vat is wasted, fill it with the lee, but if it grows too weak, supply it with half a pound of pot-ashes, half a pound of madder, one handful of wheat-bran, and half an handful of white tartar; let it stand for eight days, stirring it every 12 hours, and it will be again fit for use.

Another method for woollen.

FILL a kettle or copper with water: boil it up, and put pot ashes into it; after it has boiled with that a little, put in two or three handfuls of bran, let it boil for a quarter of an hour, then cover it; take it off the fire and let it settle.

Pound the indigo as fine as flour; then pour off the above lee to it, stir and let it settle, and pour the clear lee into the vat; then pour more lee to the sediment, stir it, and when settled, pour that into the vat also; repeat this till the indigo is wasted. Or,

Take to a quarter of a pound of indigo half a pound of pot-ashes, a quarter of a pound of madder, three handfuls of borax, let it boil for half an hour, and then settle; with this lee grind your indigo in a copper bowl; put this on an old vat of indigo, or on a new one of wood, and it will make it fit for use in 24 hours.

To dye silk of a straw yellow.

TAKE allum and rinse your silk well, as has been directed before, then take and boil to each pound of silk one pound of fustic or rocaw, and let them stand for a quarter of an hour, then put into a tub, large enough for the quantity of the silk, a sufficient quantity of that lee and fair water; in this rinse the silk; fill the kettle again with water, and let it boil for an hour, and having wrung the silk out of the first liquor and hung it on sticks, prepare a stronger lee than the first, in this you dip your silk so long till the colour is to your mind.

Another method.

PUT into a clean copper or kettle to each pound of silk, two pounds of fustick, let it boil for an hour, then put in six ounces of gall, let it boil together half an hour longer; the silk being allum'd and rinsed, is turn'd about in this colour, then

then take it out of the kettle, and wring it out; dip it in pot-ash lee, and wring it out again; then put it into the copper, let it soak a whole night, and in the morning rinse, beat it out, and hang it up to dry.

Of dying silk, &c. of different greens.

THE middling colour of blue and yellow produces a light green, grass green, laurel green, sea green, &c.

All olive colours, from the deepest to the lightest, are nothing else but green colours, which by walnut-tree root, fustic or foot of the chimneys, are chang'd to what shade you please.

A fine green for dying silk.

TAKE to one pound of silk $\frac{1}{4}$ of a pound of allum, two ounces of white tartar, put them together in hot water to dissolve, and when so, put in your silk, and let it soak all night, take it out the next morning, and hang it up to dry; then take one pound of fustic, boil it in four gallons of water, for an hour long; take out the fustic, fling it away, and put into the copper $\frac{1}{2}$ an ounce of fine beaten verdegrease, stir it about for $\frac{1}{4}$ of an hour, draw it off into a tub, and let it cool, then put into that colour an ounce of pot-ashes, stir it together with a stick, dip into it your silk, so long till you think it yellow enough, then rinse it in fair water and hang it up to dry; then dip it in the blue vat, till you think it enough; rinse it again and beat it over the pin, and hang it up to dry; thus you may change the shades of your green by dipping either more or less, in the blue or yellow.

For the green, take to one pound of silk three ounces of verdegrease, beaten to a fine powder, infuse it in a pint of wine vinegar for a night, then put it before the fire, when hot stir it with a stick, and keep it from boiling; in this put your silk two or three hours, or if you would have it of a light colour, let it soak but for half an hour, then take scalding hot water, and in a trough, rub'd over with *Newcastle* soap, beat and work it up to a clear lather, in this rinse your silk, then hang it up to dry; rinse it again in river-water, beat it well, and when it is well clean'd, and dry'd, dress it.

Z

How

How to dye linen of a green colour.

SOAK your linen over night, in strong allum water, then take it out dry; take woad, boil it for an hour long; take out the woad, and put in one ounce of powder'd verdegrease, or according to the quantity you have to dye, more or less; stir it, together with the linen, briskly about; then put in a piece of pot-ash, the bigness of an hen's egg, and you will have your linen of a yellow colour, which when dry'd a little, being put into a blue vat, will turn green.

To dye yarn of a yellow colour.

IN a copper of strong lee put a bundle of woad, and let it boil, then pour off the lee, and take to one pound and a half of yarn, half an ounce of verdegrease, and half an ounce of allum, put it into a quart of brown Brasil-wood liquor, boil'd with lee, stir it well together, and pour it in and mix it with the woad-lee; in this soak your yarn over night, and it will be of a good yellow.

To dye green yarn or linen black.

TAKE a sharp lee, put in three pounds of brown Brasil, and let it boil for some time, then pour off the colour from the chips, into a tub, add to it one ounce of gum arabick, one ounce of allum, one ounce of verdegrease; in this lay your yarn or linen to soak over night, and it will be of a good black.

To dye silk an orange colour.

AFTER you have clean'd your kettle well, fill it with clean rain water, and take to each pound of silk four ounces of pot ashes, and four ounces of orlean, sift it through a sieve into the kettle; when it is well melted, and you have taken care not to let any of those ingredients stick about the kettle, then put in your silk, which before you have prepared and allum'd as has been directed; turn it round on the winch and let it boil up, then take and wring it out, beat it and rinse it; then prepare another kettle, and take to each pound of silk twelve ounces of gall-nuts, let the gall-nuts boil for two hours, then cool for the same space of time; after which put in

in the silk for three or four hours, then wring it out, rinse, beat and dry it.

Another orange colour.

SOAK the white silk in allum water like as you do in dying of yellow: then take two ounces of orleans-yellow, put it over night in water, together with one ounce of pot-ashes: boil it up, add to it, after it has boil'd half an hour, one ounce of powdered curcumi, stir it with a stick, and after a little while put your allum'd silk into it for two or three hours, according to what height you would have your colour; then rinse it out in clear soap-suds, till it looks clear, afterwards clear it in fair water, and dress it according to art,

A fine brimstone yellow for worsted.

TAKE three pound of allum, one pound of tartar, and three ounces of salt; boil the cloth with these materials for one hour; then pour off that water, and pour fresh into the kettle, make a lee of shart and pot ashes, let it boil well, and then turn the cloth twice or thrice quickly through upon the winch, and it will have a fine brimstone colour.

A lemon colour.

TAKE three pounds of allum, three ounces of ceruse, three ounces of arsenic, with these ingredients boil the cloth for an hour and a half; then pour off that water and make a lee of 16 pounds of yellow flowers, three ounces of curcumi; then draw or winch your cloth through quickly, and you will have it of a fine lemon-colour.

To dye an olive colour.

TO dye this colour observe the first directions for dying a brimstone colour; then make a lee of gall-nuts and vitriol, but not too strong; draw your stuff quickly through, three or four times, according as you would have it, either deeper or lighter.

Z. 2

To

To dye a gold colour.

HAVING first dy'd your silk, worsted, cotton or linen of a yellow colour, take to each pound of the commodity, one ounce of sifted wood or yellow chips, and of pot-ashes the quantity of a bean, boil this for half an hour, then put in your silk, and turn it so long, till the colour is to your liking,

The Dutch Manner of dying scarlet.

BOIL the cloth in allum, tartar, falgemma, aqua-fortis, and pea-flowers, either in a pewter kettle or with aqua-fortis, in which pewter is dissolv'd; then put into the same kettle, starch, tartar and cochineal finely powdered, stirring or turning the cloth well about, and thus you may, by adding more or less cochineal, raise the colour to what height you please.

General observations for dying cloth of a red or scarlet colour.

1. **T**HE cloth must be well soak'd in a lee made of allum and tartar, this is commonly done with two parts of allum and one part of tartar.

2. For strengthening the red colour, you prepare a water of bran or starch; the bran water is thus prepared; take five or six quarts of wheaten bran, boil it over a slow fire in rain-water for a quarter of an hour, and then put in with some cold water into a small vessel, mixing it up with a handful of leaven, the sourer 'tis made, the better it is; this causes the water to be soft, and the cloth to become mellow; it is commonly used in the first boiling, and mix'd with the allum-water.

3. *Agarie*, is an ingredient used in dying of reds, but few dyers can give any reason for its virtue, but as it is of a dry spungy nature, it may reasonably be supposed, that it contracts the greasiness which might happen to be in the dye.

4. The use of arsenic is not a very necessary but a very dangerous ingredient; aqua-fortis, or spirit of salt, will supply its place as well.

5. To give a true description of scarlet, it is nothing else but a sort of crimson colour, the aqua-fortis is the chief ingredient for the change thereof; this may be try'd in a wine glass, wherein a deep crimson colour may, by adding drops of aqua-fortis to it, be changed into a scarlet, or to a perfect yellow.

6. Observe

6. Observe that you always take one part of tartar to two parts of allum ; most dyers prefer the white before the red tartar, but however, in crimson colours and others that turn upon the brown, the red tartar is chose by many as preferable to the white.

To prepare the cloth for dying of scarlet.

FIRST take to one pound of cloth, one part of bran-water, and two parts of river-water ; then put into it two ounces of allum and one ounce of tartar, when it boils and froths, scum it, and put in the cloth, turn it therein for an hour, then take it out and rinse it.

To dye cloth of a common red.

TAKE to twenty yards of cloth, three pounds of allum, one pound and a half of tartar, and one third of a pound of chalk ; put them in a copper with water, and boil them ; then take six pounds of good madder, and a wine-glass full of vinegar ; let it be warmed together, and put in the cloth, turn it round upon the winch, 'till you observe it red enough ; then rinse it out, and it will be of a fine red.

Another method.

TAKE four pounds of allum, two pounds of tartar, four ounces of white lead, and half a bushel of wheat bran ; put these ingredients, together with the cloth, into a copper ; let it boil for an hour and half, and leave it therein to soak all night ; then rinse it, and take for the dye, one pound of good madder, two ounces of orlean, one ounce and a half of circumi, and two ounces of aqua-fortis ; boil them, turn the cloth with a winch for three quarters of an hour, and it will be of a good red.

To dye scarlet.

TAKE to two pounds of goad, two ounces of tartar, and one ounce of sal-armoniac ; grind them fine, and boil them up in fair water ; add to them two ounces of starch, half an ounce of gum cotta, and one ounce of cochineal ; when these are boiling hot, put in an ounce and half of aqua-fortis, and let it boil ; then take it out, and when cool rinse it.

To dye brown colour.

BROWN colours are produced from the root, bark, and leaves of walnut-trees, as also of walnut-shells; china-root might also be used for brown colours, but it being of a disagreeable scent, it should only be used for hair colours in stuffs, for which, and the olive colours, it is of more use; the best browns are dy'd with woad and walnut-tree root.

A nutmeg colour on stuffs.

TAKE three pounds of allum, half a pound of tartar, put this into a copper of water, and boil your stuff for an hour and a half, and take it out to cool. Then take one pound and a half of fiset-wood or yellow flowers, three pounds of madder, one pound of gall-nuts; put it, together with the stuff into a copper, boil and turn it with a winch, till it is red enough, and take it out to cool; then take two pounds of vitriol, which before is dissolved in warm water, put it in the copper, and turn the stuff till the colour is to your mind; then rinse it out. *Or,*

Take half a bushel of green walnut-shells, or else walnut-tree-root, infuse it in a kettle, and when it begins to boil put in the stuff over a winch, turn it about three or four times, then take it out and let it cool; after it is cold, boil the liquor again, and put the stuff in, turn it for half an hour, and take it out and let it cool; then put in one pound of gall-nuts, three pounds of madder, together with the stuffs into the kettle, let it boil for an hour; take it out and let it cool again; take one pound of vitriol, put it in, stir it well about, then put in again the stuffs over the winch, turn and boil it so long till you perceive your colour deep enough; then take it out and rinse it.

How to make flax soft and mellow.

MAKE a strong lee of wood or pot-ashes, and unslack'd lime, in which soak your flax for 24 hours; then put it, together with the lee, into a copper, and let it boil, and it will be as soft as silk. After this rinse it in clean water; wring out

out the water, and put the flax again into a strong lee; repeat this thrice, then rinse it out, dry it, and it will answer your purpose. Some prefer cow dung, with which the flax is daubed all over, or soak it in a lee of cow-dung for 24 hours, then rinse and dry it.

An excellent water for taking out spots in cloth, stuff, &c.

TAKE two pounds of spring water, put in it a little pot-ashes, about the quantity of a walnut, and a lemon cut in small slices; mix this well together, and let it stand for 24 hours in the sun, then strain it through a cloth, and put the clear liquid up for use; this water takes out all spots, whether pitch, grease, or oil, as well in hats, as cloth, stuffs, silk, cotton, and linen, immediately; but as soon as the spot is taken off, wash the place with water, and when dry you will see nothing.

To dye woollen stuffs of black colour.

FINE cloths, and such stuffs as will bear the price, must be first dy'd of a deep blue in a fresh vat of pure indigo; after which you boil the stuffs in allum and tartar; then you dye it in madder, and at last with gall of *Aleppo*, vitriol, and *Sumach Arab**, dye it black: to prevent the colour soiling when the cloths are made up, they must, before they are sent to the dye-house, be well scowered in a scowering mill.

Middling stuffs, after they have been prepared by scowering and drawn through a blue vat, are dy'd black with gall-nut and vitriol.

For ordinary wool or woollen stuffs take walnut-tree branches and shells, a sufficient quantity; with this boil your stuff to a brown colour, then draw it through the black dye made with the bark of elder, iron, or copper filings, and indian wood.

* Is a shrub, that grows in *Spain*, *Portugal*, and *France*, from which countries it is carried in abundance to most parts of *Europe*; that which is good must be dry and of a light green colour, that of a brown hue is spent and good for little. It is used by black dyers, cord-wainers, &c. The leaves boiled in lee, dye hair black.

To dye linen of a black colour.

TAKE filings of iron, wash them, and add to them the bark of elder-tree; boil them up together, and dip your linen therein.

To dye woollen of a good black.

1. **T**AKE two pounds of gall-nuts, two pounds of the bark of elder-tree, one pound and a half of yellow chips, boil them for three hours; then put in your stuff, turn it well with the winch, and when you perceive it black enough take it out and cool it.

2. Take one ounce and a half of sal-armoniac, with this boil your stuff gently for an hour long, turning it all the while with the winch; then take it out again and let it cool.

3. Take two pounds and a half of vitriol, a quarter of a pound of *Sumach*; boil your stuff therein for an hour; then cool and rinse it, and it will be of a good black.

Another black colour for woollen.

FOR the first boiling take two pounds of gall-nuts, half a pound of Brasil wood, two pounds and a half of madder; boil your cloth with these ingredients for three hours, then take it out to cool, for the second boiling take one ounce and a half of sal-armoniac, and for the third two ounces and a half of vitriol, three quarters of a pound of Brasil, and a quarter of a pound of tallow.

Another black colour for plush.

PUT the following ingredients into a large vessel, viz. eight pounds of elder bark, eight pounds of *Sumach*, twelve pounds of oaken chips, nine pounds of vitriol, two pounds of wild marjoram, six pounds of tile-dust, some waste of a grindstone, six pounds of walnut-leaves, half a pound of burnt tartar, two pounds of salt, four pounds of woad; on these pour boiling water till your vessel is full; your plush after it is well boiled and cleansed must be well galled, and this you do by boiling it in one pound and a half of *Sumach*, eight ounces of madder, two ounces and a half of burnt saltpetre, half an ounce

ounce of sal-armoniac, one ounce and a half of vitriol, half an ounce of burnt tartar, then take it out, and let it dry without rinsing it.

Then you fill the copper with the above liquor, and boil and dye your plush in the manner as you do other stuffs, turning it round with the winch; when the colour is to your mind, take out the plush, let it cool, and then rinse and hang it up to dry.

To dye silk of a good black.

IN a copper containing six pails of water, put two pounds of beaten gall-nuts, four pounds of *Sumach*, a quarter of a pound of madder, half a pound of antimony finely powdered, four ox-galls, four ounces of gum tragacant, first dissolved in fair water, of fine beaten elder-bark two ounces, and one ounce and a half of iron file-dust; put these ingredients into the above water, and let them boil for two hours, then fill it up with a pail full of barley-water, and let it boil for an hour longer, then put in your silk, and boil it for half an hour slowly: then take it out and rinse it in a tub with clean water, and pour that again into the copper; the silk you rinse quite clean in a running water, then hang it up, and when it is dry, put it in the copper again; boil it slowly for half an hour, as before, then rinse it in a tub, and again in rain water; when dry, take good lee, put into it two ounces of pot-ashes, and when they are dissolved, rinse the silk therein quickly, then in running water; this done, hang it to dry, and order it as you do other coloured silks.

This colour will also dye all sorts of manufactured woollen stuffs.

To give the black silk a fine gloss, you must, before the last dipping, put in, for each pound, one ounce of isinglass, first dissolved in water.

Another manner for dying silk.

IN a copper of three pails of water put two ounces of borax, half a pound of *Agaricum*, a quarter of a pound of litharge of silver, four ounces of madder, one quarter of brandy, four ounces of verdegrease; let them boil together for an hour, then cover the copper, and let the liquid rest for 14 days; when you design to use it, take two pounds of *Sennes* leaves, two pounds of

of *Gentian*, one pound of *Agarica*, two pounds of granit shells; let them boil together for two hours, and then put it to the other liquor settled in the copper: this colour will keep good for many years, and the longer you dye therein, the better it will grow: you must be careful to keep it free from soap, which would spoil it so as not to be recovered by any means; and in case by accident some tallow should happen to drop from your candle into it, then forbear meddling with it till it is cold; when so, take it off carefully, or heat your poker red hot and sweep it over the surface, this will take off all the greasiness; then take two or three little bags of canvas, filled with bran, hang them in the colour for two or three hours whilst the copper is heating, then clap whited brown paper on the surface of the colour, which will take off all the greasiness that might remain; after that begin to dye.

Your silk that is to be dyed must be first boiled in bran, then galled; to each pound of silk take twelve ounces of gall-nuts; boil the gall-nuts for two hours, before you put the silk into it, which must soak therein for 30 hours.

To dye a grey colour.

GREY is a middle colour, between black and white, which beginning with a white grey, approaches by degrees to a black grey: it may be observed, that if the black colour was to be prepared only of gall-nuts and vitriol, it would procure but an indifferent grey, but if to these ordinary ingredients for dying of stuffs, you add some indian-wood, you may procure white grey, pearl colour, lead colour, whitish grey, iron grey, black grey, brown grey, &c. Some of these colours require a little tincture of the woad.

To dye a brown red colour either on silk or worsted.

FIRST, after you have prepared your silk or worsted, in the manner directed for dying of red colours, boil it in madder, then slacken the fire under the copper, and add to the madder liquor some black colour, prepared as has been shewn, then stir the fire, and when the dye is hot, work the commodities you have to dye therein, till you see them dark enough.

But

But the best way to dye this colour is in a blue vat; therefore chuse one either lighter or darker, according as you would have your colour; then allum and rinse your silk in fair water, this done, work it in the copper with madder, till you find it answer your purpose.

Another.

PUT into a kettle of hot water a handful of madder, stir it together, and let it stand a little; then take the woollen stuff, wet it first, then let it run over the winch into the kettle, turning it constantly; if you see it does not make the colour high enough, add a handful more of madder, rinsing the stuff or silk sometimes, to see whether it is to your liking.

Then put some black colour into the kettle, mix it well together, stir the fire, and when hot, turn your silks or stuffs with the winch, and dye it either of a blacker hue, by adding more black, or a redder, by putting in less.

Of madder, and its usefulness in dying of silk, worsted, cotton, &c.

MADDER is a red colour, the best grows in *Holland*, though the colour of that which grows in *Flanders* exceeds it; each sort of madder is marked with a particular mark, to know what country it comes from. The only sign of the real goodness of madder, is the bright colour, which when being ground to a fine powder, and put on a blue or brown paper, sticks to it: it must be kept close from the air, otherwise it will lose the strength and beauty of its colour.

The madder which comes from *Silesia*, under the name of *Breslaw* red, resembles more a red earth than a root, it has not so bright a colour as that which comes from *Holland*. To manure and cultivate the ground for the growth of madder, it must be observed, that it requires a good mould, which is neither too damp nor dry, it must be plow'd pretty deep, and be well dung'd before the winter season. It is sown in the month of *March* in the decrease of the moon, after the land in which it is to be sown, is well clear'd of weeds, lest they should attract the strength and goodness thereof to themselves, and their roots mix with the madder.

About

About eight months after the madder is sown they begin to pull up the larger roots thereof, which is done to hinder it from drawing the strength from the earth to themselves, which are to be a nourishment for the younger sprouts; this is commonly done in the month of *September*, when the seed is ripe for gathering. The remaining roots are then well covered with mould, till the next year, when the larger roots are again gathered; thus it is managed 8 or 10 years together, after which the spot of ground may be cultivated for the growth of corn, and a new plantation fixed upon in another place.

The roots of madder which grow in *Flanders* and *Zealand*, when pulled out are dried in the sun; but in hot countries they are dried in shady places, in order to preserve their colour and strength; after that they are ground in mills to a powder, and packed up close in casks or in double bags.

The fresh madder yields a lively colour, that of a year old a more lively one; but after that time the older it is, the more it loses both its strength and beauty.

Concerning the dying with madder.

IT has been a common rule to take to eight pounds of madder, one pound of tartar; allum and tartar are used for preparing the commodities to be dyed, for attracting and preserving the colour.

Pot-ashes heighten the colour very much, as does bran-water; brandy is of peculiar use; it attracts the colour, makes it look clear and fine, and frees the subtilest particles from its dregs and impurities. Some dyers, and indeed most, ascribe the same virtue to urine; but this is false, and although it may be of some use when fresh, it is highly prejudicial to light colours when stale, for it expels its particles of salt too much, and causes the colour to be of a heavy and unpleasant hue: this ought therefore to be a caution to such as would dye light and tender colours. The experiment may be tried in a glass of clean water, in which latmus, being first dissolved and filtered, is poured in: if to this liquid, which is blue, you pour some spirit of salt, it will turn red, and mixing it with some dissolved salt of tartar, it will resume its former colour; if you pour too much of the latter, the liquid will turn green, and thus you may change the colour by adding more or less of either the one or the other ingredient to it.

To

To dye silk of a madder colour.

PREPARE it as has been directed under the article of dying silk of crimson colour. This done put a pail full of river water into a copper, together with half a pound of madder; boil it for an hour and take care it boils not over; then let it run off clear into another vessel, stirring into it one ounce of curcumi; then put in your silk, let it lay therein till cold, then wring it out and beat it; this done take half a pound of good Brasil-wood, boil it in bran-water for an hour, clear it off in another vessel, and put in your silk; rinse it out in soap-lee, and then in running water; after which dry and dress it.

Another method.

AFTER you have prepared your silk for dying, hang it on sticks, and to each pound of silk, take eleven ounces of madder, and four ounces of nut-galls; put these into a copper with clean rain-water, hang in your silk, and augment the heat of the copper till it is ready to boil; then turn your silk in it for half an hour, and prevent its boiling by lessening the fire; after this rinse and beat it out, hang it again on sticks, in a tub with cold water, in which before you have put some pot-ashes; this gives it a beauty; then rinse and dry it. How this madder is made use of for dying of worsted or stuffs, has been shewn already.

Of cochineal and its usefulness in dying.

COchineal, a costly fine red and purple-colour, are small dry'd insects, in size of bed-bugs, which when brought into a powder and boiled, do yield a beautiful red colour, they are used by scarlet dyers, for dying of silks, worsted, cotton, &c. they are imported from the *Spanish West-Indies*, the insect feeding on a fruit which has a red juice ingendered with the tincture thereof. The *Indians* spreading a cloth under those trees, shake them, and by this means catch the insects, where they soon dye. This is the manner of preparing cochineal.

Of

Of kermes, and its use in dying.

THIS grain, by some called scarlet berry, on account of its containing that choice and noble colour, scarlet, grows in *Poland* and *Bohemia*, on small shrubs; they are about the bigness of a pepper-corn; the best comes from *Spain*; it is also found in *France*, especially in *Languedoc*, and is gathered in the latter end of *May*, and in the beginning of *June*. In *Germany* these berries are among the vulgar call'd *St. John's Blood*, because of their being found on the shrubs about *Midsummer*, or the feast of *St. John the Baptist*.

The *Poles* call it purple-grains; they grow very plentifully in that country, and that people first discovered its virtue for dying of crimson and purple, by a hen picking those berries, and discharging her excrements of a crimson colour. The district about *Warsaw* affords great quantities. In the *Ukrain* they are still more plenty; and on the borders of the sandy deserts of *Arabia*, they are gathered with great pains by the poor people, whence, it is thought, they retain the *Arabian* name of *Kermes*: those berries or grains, when ripe, contain an insect of a crimson red, which, if not timely gathered, will disengage itself from the shell and fly away; wherefore the people watch carefully the time for gathering, when they roll them together in their hands into balls, dry and sell them to the *European* and *Turkish* merchants. The *Dutch* mix it among the cochineal, because it causes that colour to have a higher and finer hue.

Of Indigo.

INDIGO is a dry and a hard blue colour, which is brought to us in lumps of different pieces or sizes; it is an *Indian* shrub, which at certain times of the year, when in blossom, is cut down and laid in heaps, so long till it is rotten: then the *Indians* carry it to the mills, which are built in great numbers about that place, where it is ground, boil'd and press'd, and when it is dry'd, they cut it in pieces, pack it in chests, and send it abroad.

There are several different sorts of indigo, viz. indigo *guatimala*, and indigo *lauro*, both which are exceeding good and

and fine; their goodness is known when in breaking they appear of a high blue, and not sandy; however that with a deep gloss is not amiss. These two sorts are followed by these, *Plato*, *Xerquies* and *Domingo*, which are counted not so good as the former. The *Indigo Plato* and *Xerquies*, are of a high violet colour, and very light in weight, so as to swim on the water; these are by some reckoned better than that of *Guatimala*, because it is press'd only from the leaves, and the other from the stalks and leaves together. *Indigo Domingo* is not of so lively a copper colour as the former, and is much mix'd with sand and earth; the merchants try this sort by lighting a piece, the good sort will burn like wax, and leave all the dross behind.

Curcumi

IS a foreign root, in the shape of ginger, of a saffron colour; it is brought to us from the *Indies*, where it is made use of both for dyers and spice

It is also called the *Indian* crocus, the best is that which is heavy and in large pieces, without dust: there is no fitter ingredient to be found for heightening the scarlet to a yellow hue, and it is frequently used by colour-dyers in tempering their reds, be they dy'd with kermes, cochineal, or madder; aqua-fortis will do the same, but curcumi adds a greater life, especially to scarlet.

Brasil-wood.

THIS comes from the country of *Brasil* in the *West Indies*; it is cut out of a tree call'd by the inhabitants *Arbontan*; which, with its stem and branches is not much unlike an oak-tree, only thicker, some will measure 24 feet round the stem; the leaves resemble those of box-trees: the finest *Brasil-wood* is cut about *Fernambuca*, a town in the country of *Brasil*, this exceeds in colour all the other kinds of *Brasil-wood*, and is therefore sold at a dearer rate: this wood produces in dying of silks, &c. a fine colour, but it is very fading. It is best for black-dyers, who by using it with gall-nuts, *Sumach*, *Rodoul*, *Fovic*, vitriol, and verdegrease, dye a good black or grey therewith.

Orchal

Orchal.

ORCHAL is prepared from a small moss which grows on rocks and cliffs, the chief ingredients for its preparation are chalk and urine, and although the colour it produces in dying of silks, &c. is fading, yet, whilst fresh, is exceeding beautiful.

Orlean

COMES from the *West-Indies*, either in square pieces like *Newcastle* soap, or in round lumps, or small cakes, the bigness of a crown, which last is reckoned to be the finest sort, and has a fragrant smell of violets; it is a tincture pressed from a seed, and, when dry'd, of a dark-red yellow colour. The druggists sell two sorts of orlean, the one is like a dough, and is very cheap, the other is dry and very valuable. The dyers use it for dying of brown-yellows, orange colours, &c.

Gall-nuts

IS a fruit of various sorts, some are small, others large black and white, smooth and knotty; they grow on high oak-trees, and by merchants are imported from *Smyrna*, *Tripoly*, *Turky* and *Aleppo*; the heaviest are counted the best, especially when black and knotty.

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